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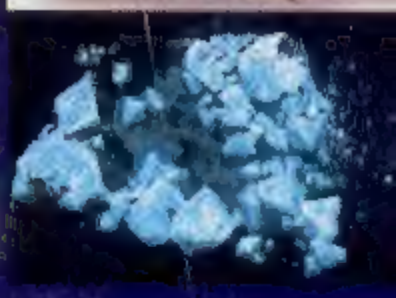

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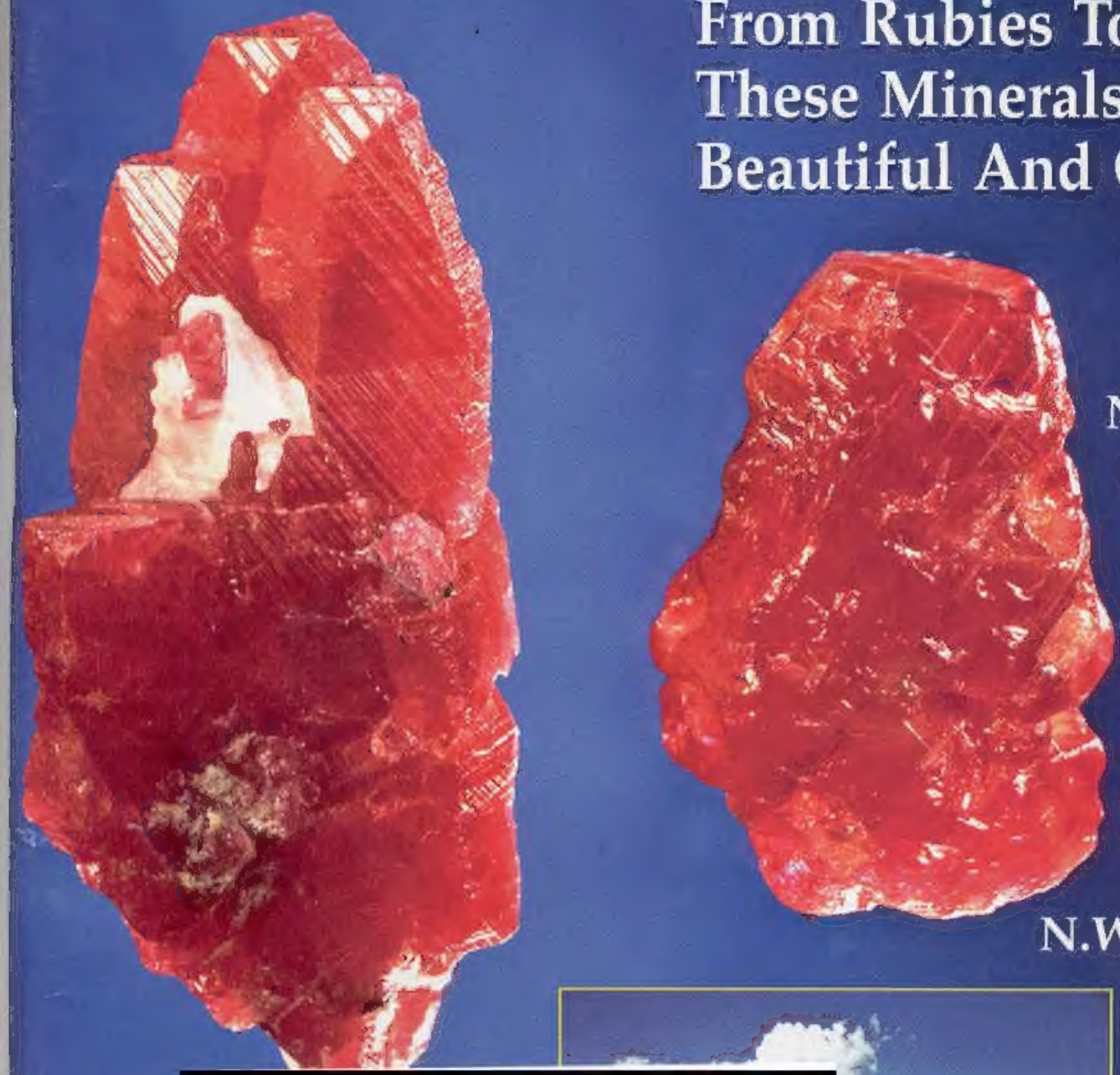

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COVER: These world-class ruby crystals from Sri Lanka (left) and Burma (right) are in the collection of John Barlow in Appleton, Wisconsin. Ruby is an aluminum oxide mineral. (Earl Lewis photo)

REGULAR FEATURES

Craftsman of the Month 6
Show Dates 8
Shop Talk 18
Lapidary Lore and More 26
Off the Dop 32
John Sinkankas Memorial Editorial Award 38
Picks & Pans 46
Many Facets 64
How to Subscribe 77
Rock Science 86
On the Rocks 96

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Volume 34, Number 9

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The Frugal Collector:
The Oxides 12
Part 1: Cuprite, chalcotrichite, rutile, and cassiterite;
by Bob Jones

The Wonderful World of Road Cuts 20
How many collecting sites have you driven past?
by William A. Kappele

Fluorescent Scheelite and Powellite 28
Ultraviolet light brings out their hidden beauty;
by Stuart Schneider

Panning Sites along U.S. Highway 385 34
Seven spots in South Dakota;
by David and Clois Walker

Project:
Make a Sterling Silver Bookmark 40
This simple project is a special keepsake;
by Diane Prokop

Rock & Gem Kids 48
A look at apatite and magnetite;
by Steve Decker

A Teary Salute 56
9/11 victims receive a tribute in quartz;
by Bob Jones

Field Trip
Monroe County Meanderings 60
Collecting Southern Indiana geodes;
by Mike Streeter

Diamonds of the Northwest Territories 66
Canada's Diavik mine will produce 6 million carats per year!
by Steve Voynick

Rockhound State Park 72
Finally, a state park that welcomes collectors;
by Kenneth H. Rohn

Field Trip
Copper Minerals of Saginaw Hill 80
The only collecting tool you need is a bucket;
by Roger Matthees

Field Trip
Lake Valhalla Serpentine 88
This is serpentine of an unusual color;
by Robert Beard

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THE FRUGAL COLLECTOR

THE OXIDES

PART I:

Cuprite, Chalcotrichite, Rutile, and Cassiterite

by Bob Jones

The oxides are an interesting group to study because they offer the collector a range of simple to complex chemical compounds from a host of environments. Some can be faceted into fabulous gems, while others are as dirt under your feet. This is because the oxide group contains such gem minerals as ruby and sapphire and such common minerals as the rust on your car!

Oxides are among the more stable minerals we find. Most resist corrosion, and their atoms are not easily separated because the bond between the elements that make up the oxide mineral molecules is not easy to break. That bond is what makes gems like ruby and sapphire both hard and resistant to chemical attack.

To understand the stability of oxides and their resistant nature, you must have a little understanding of the forces involved in mineral chemistry. All compounds are composed of one or more metals or elements that act like metals. These are called cations. Cations join with anions, the nonmetal elements, to make a compound.

Take ruby, for example. Ruby is composed of aluminum, the cation, and oxygen, the anion. The metal element cations tend to give up electrons to nonmetals like oxygen or sulfur. Anions, the nonmetals, tend to take in electrons given up by the metal cations. This is oxidation, a process so named because oxygen is the most common anion that takes in electrons from metal atoms, so in effect, the metal ion is oxidized. Other nonmetals, sulfur and fluorine for example, can function in the same way, but oxygen is by far the most common and active of the nonmetals.

This giving and receiving of electrons, when evenly done, is an ideal situation because the resulting compound (we call them minerals) is stable and a state of equilibrium is reached. So in ruby, aluminum gives up electrons to oxygen, which willingly takes them. When the two elements have completely satisfied each other, they are stable, or in equilibrium, and any compound in equilibrium is difficult to tear apart.

Cuprite, coated with malachite (bottom) and cut into a 70 carat red gem, is a copper oxide mineral. (Jeff Kurtzeman photo)

All this brings us to quartz (silicon dioxide). The silicon, which is called a semimetal because of its electron structure, acts as the cation in the quartz compound. The oxygen acts as the anion. A silicon atom has four electrons, which it grudgingly gives up, but an oxygen atom only has room to accept two electrons. So to reach equilibrium, it takes two oxygen atoms to one silicon atom. Because these two elements have reached stability when joined one to two, the resulting quartz is very resistant to change. For example, there are not many acids that can attack quartz. And we all know quartz is fairly hard, another useful property. Because quartz is composed of one silicon atom joined with two oxygen atoms and nothing else, it should be obvious that quartz must be an oxide. If only it were that easy.

The problem here is that the silicon dioxide molecule also forms the core of the largest group of chemical compounds, or minerals, which we call silicates. Here we have a much more complex interaction of cations and anions, as many other elements join with the silicon and oxygen molecule, or silicate, to create this large group of minerals. There was for a long time a real battle going on among chemists and mineralogists as to where to classify quartz. Was it an oxide or a silicate? Some early textbooks list it with the oxides. Englishman Henry A. Meirs, a professor of mineralogy, classified quartz as a dioxide not a silicate in his 1902 textbook *Mineralogy*, which was reprinted in 1929. All modern texts favor the silicate view, however, so that is what I will call it in this article.

The gems that are oxides are not only hard and resistant to acids, but they can be very colorful. Again, think of ruby and sapphire and add such gems as spinel, which can be red or blue, chrysoberyl, which can be a lovely yellow-green, or alexandrite, which shows one of two colors. Even such oxides as cuprite (a copper oxide), rutile (a titanium oxide), and cassiterite (a tin oxide) can be

colorful, though they lack the hardness to be suitable as useful gems.

The whole reason there are oxide minerals is because the Earth has an abundance of the very chemically active nonmetal element oxygen. In fact, nearly half the entire weight of the Earth is estimated to be oxygen. This seems more acceptable when you realize the size and depth of the watery oceans. By volume, oxygen is an astounding 90 percent of the Earth! No wonder its role in forming minerals is so profound.

Water, as we all know, is two atoms of hydrogen and one of oxygen. Again, the oxygen is accepting two electrons, one each from the two hydrogens. So, we refer to oxygen as H_2O. To be absolutely accurate, however, we should write the chemical formula HOH. This is really an incomplete way of describing water, as it implies there is just one form of water. When I was teaching science, I used to tell my students there are at least 33 different types or forms of water molecules!

How can that be? How can something so simple, a two-hydrogen, one-oxygen chemical compound, have so many variations? The answer, in a word, is isotopes, those atoms with a different nuclear or atomic weight from the normal. A hydrogen atom, if not normal, can have either of two isotopes. You've heard of heavy water. That refers to water whose hydrogen has more than the normal atomic weight of one. Normal hydrogen lacks any neutrons in its nucleus. But hydrogen can also have either one or two neutrons in its nucleus. We call these isotopic forms of hydrogen deuterium and tritium, terms you've undoubtedly heard before. There is really nothing to prevent any one of these three forms of hydrogen from combining with one oxygen atom to form water since the formation of a water molecule is based only on an electron exchange and does not involve the nucleus at all.

Small copper crystals protrude from superb octahedral crystals of cuprite (Evan Jones collection). (Bob Jones photo)

When manganese oxide invades the cracks in agates or silicified wood, the result is lovely, scenic dendrites. (Bob Jones photo)

Thousands of native copper specimens coated with cuprite crystals were mined at Ray, Arizona, years ago (Evan Jones collection). (Bob Jones photo)

There are no special names for oxygen's isotopes. Rather, we simply refer to them by their atomic weight. The atomic weight of normal oxygen is 16, meaning there are eight protons and eight neutrons. But there are also two isotopic forms of oxygen, O-17 and O-18, wherein one or two extra neutrons get into oxygen's nucleus. So, if you factor in the variations possible when combining any of three different oxygen forms and three different hydrogen forms, the chemical/molecular possibilities for water grow considerably.

About 99 percent of all water consists of normal oxygen and normal hydrogen, with a total atomic weight of 16+1+1. But when any or all the isotopic forms of hydrogen or oxygen enter the water's molecular structure, the total atomic weight differs from the normal.

Any discussion of the effect of these different isotopes on mineral compounds is beyond the scope of this article. However, it is worth saying that when we are trying to decide whether a rock had a metamorphic or igneous origin, we can use the ratio of O-16 to O-18 in the rock to tell the difference. This is because the heavier O-18 atoms usually settle deeper in the Earth's crust, where metamorphism is more common. What is more important to this discussion is to realize that oxygen plays a major role in the breakdown of most mineral compounds. This is because air brings plenty of oxygen to bear on rock and mineral surfaces. More important, oxygen readily dissolves in water, and that combination of dissolved oxygen and water speeds the breakdown of minerals in rocks. Since water holds dissolved oxygen and water facilitates the movement of atoms during mineral breakdown, things tend to decompose more rapidly in water than in air, even though air has a higher percentage of oxygen available. This is why wet iron will rust faster than dry iron. It's why native copper, as surface water trickles into and through an ore deposit, will gradually develop a lovely red cuprite coating!

continued on next page

Given the fact that the oxygen in water—and that's dissolved gaseous oxygen, not the O in HOH—and the oxygen in air cause the development of most oxides, we can assume that most oxides form at or near the surface of the Earth. This is why we refer to the upper part of a metal deposit as the oxide zone and the compounds found there as oxide minerals.

The favorite oxide of most people is probably ruby or its corundum counterpart, sapphire. After all, they are colorful and valuable, and provide us with spectacular gems. But as a mineral collector, especially one who specializes in copper minerals, I prefer cuprite. It comes in quite a variety of forms from cubes to octahedrons to dodecahedrons. But it can also be a tangled mass of brilliant red hairlike fibers, which we call chalcotrichite, from the German words chalco (copper) and trichus (hair).

Cuprite never occurs in large crystals—most are well under an inch—with two significant exceptions. One is a few stunning, gem-quality, bright-red cubes, one of which is nearly 2 inches in one direction, that have occasionally been found in the copper mines at Bisbee. The finest crystal, a nearly 2-inch gemmy, cubelike red crystal, was found a few years ago.

Another and more recent source of large cuprite crystals is the Emke Copper Mine in Onganja, Namibia. Miners broke into a wall lined with crystallized calcite, and sitting on the calcite were huge, modified, gemmy cuprites coated with bright-green, often rough-surfaced malachite. Each cuprite showed a cubo-octahedral form, and many reached nearly 2 inches across. All have a gemmy interior. Some crystals were intergrown in tight clusters, but most were individual crystals on calcite. The crystals that were broken in mining provided excellent faceting material, and large collector gems were cut. The largest I've seen reached 70 carats. Once cut, many of these gems developed a metallic sheen that is not unusual for cuprite. Because of cuprite's low hardness, faceted gems of this red material are strictly for display and cannot be worn in jewelry.

Even though most copper mines have long since been mined down through their oxide zones, there is still an abundant supply of cuprite to be had by the Frugal Collector. This is because so many copper deposits in this country are located in the desert, where oxidation penetrated to depths of more than 1,000 feet. That created conditions suitable for huge and often deep cuprite-rich zones. Therefore, cuprite occurred so abundantly in desert copper deposits it was a major ore, and because it is an attractive mineral, it was often salvaged by miners for sale to collectors.

For example, when underground mining at Ray, Arizona, became less profitable decades ago, it was decided to develop the mine into an open pit. So in the early 1950s, the Pearl Handle pit was started. Immediately, miners encountered a vast zone of native copper, with cuprite crystals in small modified cubes completely coating the long, slender, branching wires of copper. These lovely cuprite-coated arborescent copper wires are still seen for sale today. It is interesting to note that the cuprite on Ray copper was so abundant that an undertaker in nearby Globe, Arizona, used to trade his skills for mineral specimens. He accumulated a huge quantity of Ray cuprite-on-copper specimens. Miners in this remote area east of Phoenix would often trade such specimens to visiting collectors. One collector I know traded grapefruits and oranges for cuprite-on-copper specimens, and he ended up with a large quantity of them.

Rutile, a titanium oxide, forms lustrous black crystals at the Champion Mine at Graves Mountain, California. (Bob Jones photo)

The Chino Pit in Santa Rita, New Mexico, was almost as prolific as Ray in producing cuprite. Again, the red cuprite developed as crystalized coatings on arborescent native copper. Just as at Ray, quantities of this material were saved and entered the specimen market.

You may wonder why so much cuprite is found on native copper. The native metal is often a secondary mineral; it forms from the primary sulfides like chalcopyrite, thanks to the oxygen in groundwater that attacks the sulfides. As the native copper forms, the oxidation process continues relentlessly and cuprite or tenorite, a black copper oxide, is the result. Cuprite on copper is most often a thin surface alteration or coating, but can often be of sufficient quantity to form small crystals.

Not all cuprite forms on copper. Thick zones of solid cuprite have been found at Tsumeb, Bisbee and a host of other copper mines as solid masses. This is mined as a major ore of copper. Where there are small to large openings available, superb usually cubic cuprite forms as vug linings as well crystallized specimens. The larger crystals of cuprite tend to be darker red to almost black, and most show a light metallic sheen, especially after being exposed to that good old element oxygen! This is particularly true after long exposure or in a humid climate.

Other copper deposits noted for cuprite are the Bingham, Utah, pit; Cornwall, England; Bogoslovsk, Ural Mountains; Mount Isa, Australia; and an interesting, now-classic deposit at Chessy, France. The Chessy cuprites are much sought. They are almost always single octahedrons, sometimes with slight cube modifications. The vast majority are coated with, or sometimes completely replaced by, malachite. The larger crystals reach nearly an inch. These cuprites are found loose in clay in the now-closed Chessy deposit. The Frugal Collector who finds one of these crystals is fortunate indeed.

One of the more interesting occurrences of cuprite is the dull to good red copper oxide coating found on some Bronze Age implements. Since bronze is a copper alloy, it is not unusual for cuprite to develop as a weathered coating on these items.

A less common, but exceptionally beautiful, form of cuprite is the brilliant red to orange-red cuprite we call chalcotrichite. Exceedingly fragile, for they can be crushed flat, these hairy tangles of bright-red cuprite stand out like a beacon in any collection. Fine specimens are not at all common. The hairlike form of this variety of cuprite results from a very rapid growth of the crystal structure in only one direction.

Chalcotrichite can also add color to other minerals, especially calcite. In rare instances, calcite will develop after and completely enclose the red chalcotrichite hairs. Fine specimens like this are the crown jewels of the cuprite family and rare indeed.

continued on page 16

The Oxides *from page 14*

Rutile is a widespread titanium oxide mineral. It has even been mined as beach sand consisting mainly of rutile to obtain titanium, a valuable metal. For collectors, there are several forms of rutile worth pursuing. It forms in the tetragonal crystal system, but is most often seen as needles of golden to red hue. It frequently shows up in quartz as an oriented inclusion, resulting in an excellent gem material. Sometimes, the rutile needles seem randomly scattered throughout the quartz. But the more spectacular rutile-in-quartz specimens are from Bahia, Brazil, where golden rutile is oriented as radiating six-rayed stars anchored to ilmenite, all locked in quartz.

In stark contrast to the golden needles of rutile from Brazil are the blocky rich brown, brown-red, or black crystals found associated with iridescent kyanite and pyrophyllite at Graves Mountain, Georgia. At one time, collecting at Graves Mountain was easy, and huge quantities of these showy specimens were seen frequently. That's no longer true. Still, a lot of these lovely crystals, many of them twinned, were found, and a fine specimen will occasionally be seen for sale at a show.

The Georgia rutiles range in size up to 5 inches long, and are perhaps half as wide, or even equidimensional, with smooth faces and high luster. These crystals are among the best specimen rutiles ever found.

The Champion Mine in Laws, California, is a source of rutiles very much like those from Graves Mountain. They, too, are blocky, lustrous, and sometimes equidimensional, but reach an inch or more in length.

Another type of rutile to watch for is the tiny red prisms oriented on the faces of bright black hematite, an iron oxide. Many of the superb hematites found in the Swiss Alps are enhanced with these rich red rutile crystals, seldom more than ¼ inch long and as thin as a pencil lead. Similar red rutiles are occasionally found on dark-brown siderite rhombs in western North Carolina.

For the lapidary, rutile can be one of the needlelike sprays of crystals seen along the edges of an agate slice. Given the name sagenite, these enclosed sprays add a nice touch to a banded agate form.

At one time, a quarry at Magnet Cove, Arkansas, produced some very interesting rutiles. The crystals formed geniculating twins. This term describes a bent-knee form. If the rutile twin repeated again and again, it would actually form an enclosed, six-sided, bulging disclike twin. There may be a hole in the center of this twinned form or not. Such crystals are striated, black, and quite rare. This rutile also formed pseudomorphs after brookite, another titanium oxide.

The gem pegmatites of Brazil produced considerable numbers of quartz crystals with enclosed golden rutile needles. These gem deposits have on rare occasions produced really spectacular individual rutiles with a rich gemmy hue ranging from brown to yellow. These crystals can form V or butterfly twins. The mine at Itabiara, Bahia, is well known for its exceptional, but rare and very pricey, rutile twins. Again, these rutiles will occasionally repeat the twinning to form a six-sided enclosed grouping.

Romanchite, a manganese oxide, forms hairy coatings on solid manganese oxide from the Roy Mine near Lordsburg, New Mexico. (Bob Jones photo)

Another metal oxide that forms geniculating twins is cassiterite. Six crystals can join end to end to form a six-sided, thick disc, but more often, cassiterite is found as two crystals twinned at an angle. The twinning is easily spotted, as there is a small "V" reentrant angle visible.

Cassiterite is a tin oxide found in high-temperature veins. It has accumulated some interesting names through the centuries. When massive, it can be called wood tin, as it looks like the light/dark grain of wood. Cornish miners would find small rounded nodules of this banded material that they called toad's eye tin!

Zinnwald and Schlaggenwald in the mountainous Erzgeberge region of Germany have produced wonderful single and twinned cassiterites. Most were superb dark brown to nearly black twins with high luster in good sizes to an inch or more.

continued on page 50

The Oxides *from page 16*

Of greater abundance were the cassiterites found at Llallagua and Araca, Bolivia. In fact, the tin mines of Bolivia have been the major source for cassiterite crystals. Some of the Bolivian cassiterite comes in light- to medium-brown needles that taper to a point and form in tight masses weighing dozens of pounds. Still other specimens are of the wood tin variety, forming in botryoidal masses showing light- to dark-brown banding. A series of mines in Mexico's Sierra de San Francisco range produced huge masses of similar botryoidal wood tin, which were commonly seen some years ago.

The finest cassiterites are superb mahogany brown crystals, singles and twins up to 2 inches on an edge, from Araca, Bolivia. The Bandy collection, now on display in the Los Angeles County Museum of Natural History, has a solid mass of 2-inch dark-brown Araca cassiterite crystals that weighs in at 75 pounds!

The tin mines of Cornwall, England, are a classic locality. The ore zones here are interesting in that they show the effect of the conditions present during the deposition of minerals. The Cornish mines are found clustered around huge granitic intrusions where hydrothermal ore-bearing solutions radiated out from the granitic intrusive formations into the surrounding ancient rock, locally known as killas. As the solutions moved away from their source, they slowly cooled and certain minerals were deposited, depending on their temperature of formation.

Cassiterite is a high-temperature mineral, so it would begin to develop descrete crystals fairly quickly. As the solutions continued moving away from the granite intrusions, other minerals, copper in particular, would begin to crystallize. It was not unusual for miners extracting an abundance of cassiterite ore to gradually begin to hit copper minerals, which would increase in quantity as cassiterite production slowed and eventually stopped. Think of the way an onion is formed in layers. In a crude way, that's what the Cornish deposits resembled, with succeeding layers of different metals.

Luckily for the Frugal Collector, China has come on line with a good supply of cassiterites. They often have a brilliant luster, are usually black, and may be twinned. Hunan Province is the source of these tin oxides. Another recent source is the pegmatites of Afghanistan, where a limited number of huge crystals, some to 4 inches on an

continued on page 55

edge, have come to light. Mining here is sporadic, and gem crystals like beryl and tourmaline get first consideration during specimen mining.

The same is true of the pegmatites of Pakistan around Stak Nala. The obvious problem is that cassiterite does not have the sales appeal of the gem tourmalines, kunzites, and other pegmatite minerals. Since mining and transportation are difficult, the high-value gemmy specimens are extracted first.

Manganese is a fairly common metal that easily forms manganese oxide minerals. In fact, the real problem with manganese oxide is that it isn't just one mineral compound. It is found in a host of varieties, so it is almost impossible to distinguish one manganese oxide from the next. These minerals even form intimately associated with each other, making field identification impossible.

The element manganese is one of the transition metal elements. That means the outer electron arrangement of the element can offer two, three and even four electrons as a cation when joining with an anion to form a mineral molecule. That means there are several possible combinations of manganese oxide, most of which are amorphous (crystals do not form). Rather, much manganese oxide is actually a whole series of ugly, dull, black, usually extremely soft manganese oxides, several of which end up being called wad. This is like referring to the several minerals in the feldspar group as feldspar rather than albite or microcline and so on. Out of this family of manganese minerals, only a couple crystallize, including pyrolusite, ramsdellite and psilomelane. But distinguishing one from the other is just about impossible for the average collector.

Of considerable interest to the lapidary is the role manganese oxide plays in agates, chalcedony, chrysoprase, and several other semiprecious gems. When manganese oxide is completely dissolved in watery solutions, it can seep into any small crack or opening in the rocks and form crystals that can only grow in the restricted space. The result is very attractive branching black networks of microscopic crystals that we call dendrites. These lovely arborescent images can turn a drab gray pebble of chalcedony or a vibrant red to yellow slice of petrified wood into a very attractive gem. In agate, these dendrites usually "grow" from the outer edge inward. They can turn a rather featureless agate rim into something far more interesting and attractive. This means any Frugal Collector can have a very attractive manganese oxide specimen in a collection, though it may be less manganese oxide and more agate or chalcedony.

Burmese and Cambodian rubies are very valuable aluminum oxide gems. (Jeff Kurtzeman photo)

Some manganese oxides are collectible. Best known is pyrolusite, which sometimes forms respectable crystals. Some of the best crystal clusters came from Germany years ago. The lack of interest in black minerals probably plays a role in such minerals seldom being seen today.

Here in Arizona, the appropriately named Black Widow Mine taps a rich manganese oxide deposit. Along with a household of rattlesnakes that seem to always lurk around the entrance, the Black Widow produces fine crystals of pyrolusite, which here are called polianite, and manganite, another manganese mineral. The polianites are heavily striated in stubby crystals with a reasonable luster. But collecting in the Black Widow is an exercise in filth; you emerge from a black hole looking more like a coal miner than a rockhound.

Pyrolusite gets its name because it is used in taking the greenish tint out of molten glass. The green color is due to iron oxide, which was part of the silica sand used in the glass-making process. When manganese oxide is added to the melt, the green color disappears. Pyrolusite's name comes from pyro-, meaning "fire," and louein, meaning "to wash."

Few, if any, manganese oxide specimens will be seen for sale at shows these days. But the role it plays in enhancing agates, petrified wood, chalcedony, and other semiprecious gems is important, and any Frugal Collector can add such beauty to a collection shelf.

Part II of "The Oxides" will address the iron oxide family. The variety of iron compounds combined with oxygen is considerable because, like manganese, iron has a variety of electron valences available to join with oxygen to form a suite of collector minerals.

SHOP TALK

by William A. Kappele

How I Got Started

Many of you have written me over the years to tell me about your field trips and rockhounding adventures, and how you got started in the hobby. I thought it would only be fair to give you a brief glimpse into how Cora and I got hooked, and to offer some of our tips for successful field trips.

I imagine that there are as many ways to become a rockhound as there are rockhounds, but for our family it all began with a piece of agate that Cora spotted in the berm as we drove along a dirt road up in Utah years ago. At that time, we didn't know agate from a Snickers bar, but we did know that what she found was very pretty and that we would like to find more. Consequently, we began to look for "pretty rocks" wherever we went in our camping and fishing expeditions. Cora's uncle had a neighbor who was a rockhound (a term we had never before heard), and he identified our original find. We thought it was great to have found agate, although the kids might have wished it had been a Snickers bar.

Time ticked away, and our collection was growing. Somewhere along the line, we discovered that there were actually magazines and books about collecting rocks and what to do with them after they were collected. We were hooked! We discovered that we could find maps and directions to places where collecting could be more than mere chance. Up to this point, we would occasionally find nice rocks in places where we happened to be for a far different reason. Now we could go to spots just to find rocks, and maybe we could do a little camping or fishing along with the collecting.

We soon discovered a few basic truths about field trip guides and articles, though. First, watch out for directions. "Go 2.3 miles to a haystack and turn north," sounds easy enough, but does your odometer match that of the writer's vehicle? Haystack? Maybe it was there for a reason. We once followed directions in an article that had a dead horse as one of the landmarks. Fortunately, the article was new, and so was the dead horse, so we found what we were looking for. If your directions are 10 years old, a lot will have changed. Dirt roads come and go (and so do dead horses).

Another thing to take with a grain of salt is descriptions of the material to be

found. One of our favorite guidebooks would talk of "tons of agate and jasper in vivid reds, brilliant purples, breath-taking yellows, etc., etc., etc." We would drool over those descriptions until the print ran, but the reality was usually quite a bit less spectacular. As to "tons," remember that it doesn't take much rock to make a ton, and there is a lot of land out there.

The main things for a novice to remember on a field trip are:

1. Know how current your maps and directions are.
2. Know the limitations of your vehicle.
3. Allow yourself plenty of time for the trip.
4. Have all of your emergency and safety equipment in good order.
5. Know that it will probably take longer to get there than you think, and that you will probably have to walk farther and search harder than you planned.

If you follow these simple precautions, you will be on your way to one of the most satisfying hobbies you could have chosen.

Please feel free to contact me if you have a suggestion or comment about this or any of my Shop Talk columns. My e-mail is quappelle@cox.net, or write to me at 25231 Pericia Dr., Mission Viejo, CA 92691.

The Wonderful World

Collecting Minerals Is Easy When You Know Where to Look

Some of the nicest satin spar around can be found in a Perry Park, Colorado, road cut. (Photos by the author)

Malachite and azurite stain this rock from the Mason Pass Road cut in Nevada.

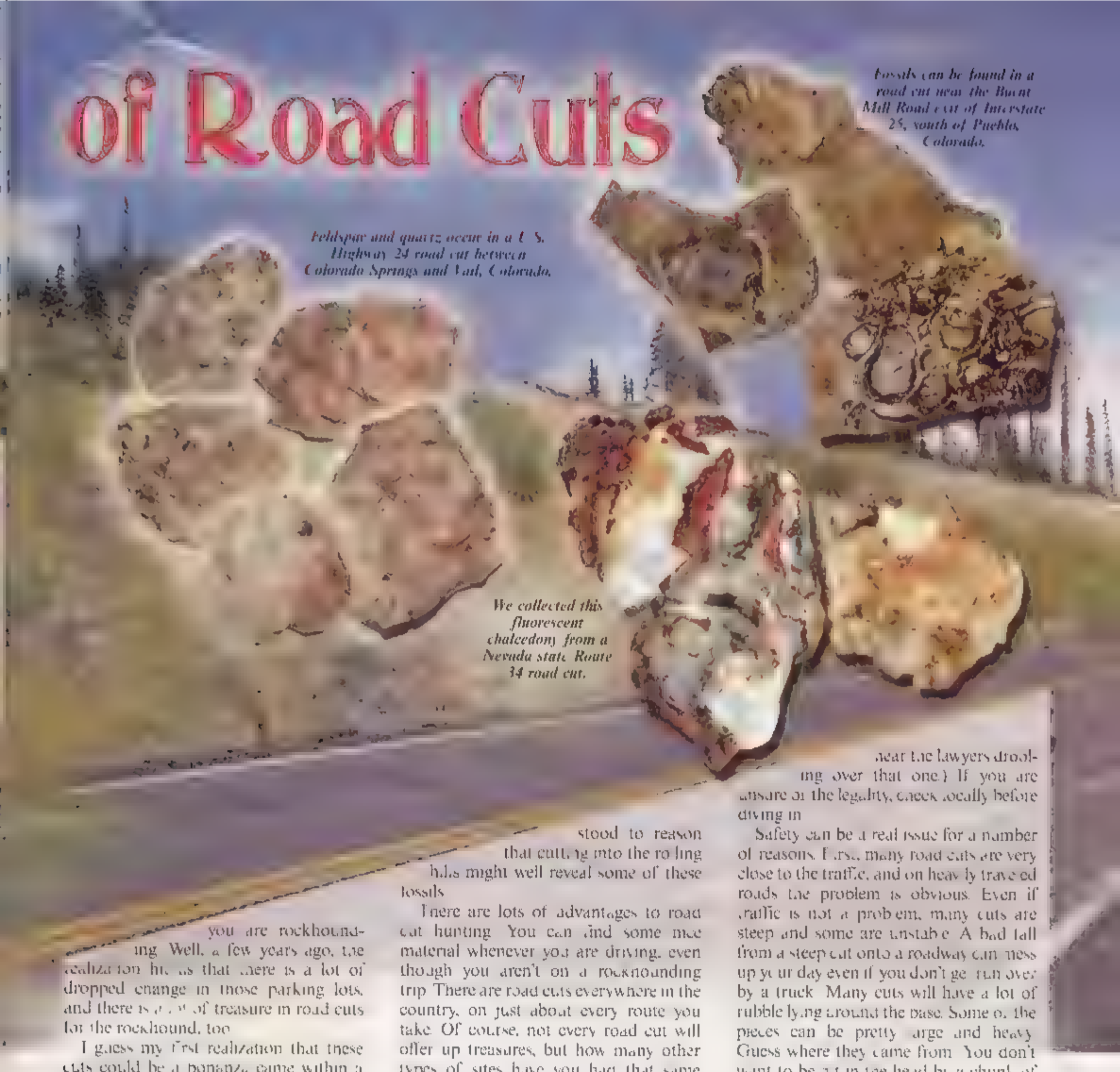
by William A. Kappele

Up until the time when Cora and I started writing rockhounding guidebooks on Colorado, Utah and Nevada for Falcon Press, we had the idea that the only way to find rocks was to drive a vehicle as far as it would go, then hike a few miles, break up a boulder, toss some pieces into the rock bags, and backtrack to civilization with our treasures. We also subscribed to the theory that the farther one got from the road, the bigger and better the material became. Sometimes this was true, but, unfortunately, a lot of the time it wasn't.

Hiking and hunting for treasures was part of the fun, so that's what we did. Writing the guidebooks gave us a different perspective, though. We realized that we shouldn't just write about trips for other crazy people, but for those who didn't have four-wheel-drive, didn't want to go miles and miles into the middle of nowhere, and couldn't, or didn't want to, hike out in the desert or up in the mountains. We wanted to address the needs of older folks and younger families with kids who would like to find some rocks or fossils, but who didn't necessarily want to dedicate their lives to it, and travelers who would like to stretch their legs and make it pay off in some small treasures.

Of course, we had known about hunting in road cuts since we first began in the hobby, but it always seemed a lot like wandering around the WalMart parking lot looking for dropped change. Everyone knows you're supposed to be hot, sweaty, thirsty, and a long way from the car when

# of Road Cuts



Fossils can be found in a road cut near the Burnt Mill Road exit of Interstate 25, south of Pueblo, Colorado.

Feldspar and quartz occur in a U. S. Highway 24 road cut between Colorado Springs and Vail, Colorado.

We collected this fluorescent chalcedony from a Nevada state Route 34 road cut.

you are rockhounding. Well, a few years ago, the realization hit us that there is a lot of dropped change in those parking lots, and there is a lot of treasure in road cuts for the rockhound, too.

I guess my first realization that these cuts could be a bonanza came within a few miles of our home. We had just moved to south Orange County in Southern California, about 37 years ago, and the area was not yet covered with housing, concrete and asphalt. There were lots of roads winding through the rolling hills, however, and one in particular had a small cut that had been covered with a tar or asphalt substance. My curiosity got the better of me, and I called the highway department to ask what it was. It turned out that they were forced to cover the bare cut to keep fossil hunters from digging it up and causing erosion, which rained rubble on the roadway. I realized that since Orange County was a very fossil rich area—mammoth tusks, saber-toothed cats, whales, and marine fossils had all been found here—it only stood to reason that cutting into the rolling hills might well reveal some of these fossils.

There are lots of advantages to road cut hunting. You can find some nice material whenever you are driving, even though you aren't on a rockhounding trip. There are road cuts everywhere in the country, on just about every route you take. Of course, not every road cut will offer up treasures, but how many other types of sites have you had that same experience in? Road cuts are also easily accessible. They occur along freeways and paved secondary roads everywhere. Of course, they also exist along four-wheel drive roads, too. Be sure to keep your eyes open for new construction and road-widening projects. Remember that the first folks there have the best pickings.

There are some things to be aware of before you start, though. Hunting in these cuts is not always legal. States and counties have their own rules for hunting. In Kentucky, for example, we were told by the State Highway Department that, while they did not especially like people digging in their road cuts, they figured that if you were goofy enough to climb around too close to the road, it was your problem if you had an accident. (I can hear the lawyers drooling over that one.) If you are unsure of the legality, check locally before diving in.

Safety can be a real issue for a number of reasons. First, many road cuts are very close to the traffic, and on heavily traveled roads the problem is obvious. Even if traffic is not a problem, many cuts are steep and some are unstable. A bad fall from a steep cut onto a roadway can mess up your day even if you don't get run over by a truck. Many cuts will have a lot of rubble lying around the base. Some of the pieces can be pretty large and heavy. Guess where they came from. You don't want to be hit in the head by a chunk of rock, so keep a sharp eye out. If you are very close to a heavily traveled road, you don't want to dislodge a piece of rock that could hit a vehicle, either.

Be careful not to dig holes that will cause erosion. You could be responsible for collapse of the cut and/or cause the area to be closed to collecting. Parking is often a big problem, too. Much of the time, it is necessary to park quite a way down the road and walk back. Think of how far you have walked to those remote sites out on the desert or up in the mountains, though. A little walk down a nice smooth road shoulder is a walk in the park in comparison—and your last might find something to make it all worthwhile.

continued on next page

The Wonderful World of Road Cuts *from page 21*

Once Cora and I realized that road cuts could be a worthwhile source of rocks and fossils, we started looking at them wherever we went. A few years ago, we were doing research for a book on scenic driving in Kentucky. We didn't know much about rockhounding in the area, but we came across a huge road cut near Wolf Creek Dam at the southwest end of Lake Cumberland. We parked and poked around a bit and came up with some nice fossil shells. Fossil hunters take note: There are miles and miles of limestone road cuts in Kentucky.

Since then, we've searched a lot of road cuts and found some nice specimens and some leaverite. The following sites in Colorado, Utah and Nevada are just some of the ones we have visited.

COLORADO

Cochetopa Dome From the intersection of U.S. Highway 50 and state Route 114, go south on state Route 114 about 20 miles to Saguache County Road NN14. Turn right on NN14 and go just over 4 miles to County Road KK15. Just past the junction, there is a big road cut on the left side of NN14. Hop out and fill your bag with Apache tears.

Green Mountain Reservoir There is a huge road cut along Green Mountain Reservoir on state Route 9, about 10 miles south of Kremmling and 15 miles north of Dillon. The cut is a good 5 miles long. Pelecypod and cephalopod fossils are plentiful. A small trowel and a screen will be a big help.

Gypsum This is a great site for travelers, since it is just a few feet off Interstate 70, approximately 25 miles east of Glenwood Springs. The cut is on a dead-end road that parallels the freeway. Leave the freeway at exit 140, go north on the frontage road, and immediately west to the site. You can't miss it, and you can collect great specimens of selenite. You will probably use up all of the Kleenex in the car wrapping them, though.

Wolcott If you visited Gypsum and are heading east, this is a natural. Take exit 157 from I-70 and head north on state Route 131. At just over 2 miles, a road goes right. Turn onto the road and park in the wide area on the north side. There are small pelecypod fossils in the gray shale of the cut. Keep your eyes peeled for some small calcite crystals, too.

Meyers Ranch Road Cut If you find yourself on state Route 9 between Hartsel and Canon City, keep a lookout for this small pegmatite. If you are going north, it is 6.5 miles from the Guffey turnoff. From Hartsel, it is 19.2 miles from the junction with U.S. Highway 24. Parking is a quite a way down the road, but there is enough nice quartz, pink feldspar, and muscovite mica to make the walk worthwhile. It is close to the road, so be careful.

Highway 24 Road Cuts This is another great site for travelers. The well-traveled section of U.S. Highway 24 between Colorado Springs and Vail goes through some of the most beautiful scenery in Colorado. It is also a gateway to a lot of famous rockhounding sites. People with their sights set on other places tend to miss some good collecting fun right next to the road. If you are going west, look for the road cuts as you get close to Florissant. If the sun is right, the cuts will sparkle with mica flakes. A little poking around will net you some nice pink feldspar, clear quartz and even mica. Some spots have good parking pullouts, some have fair ones, and others have none at all. Do you suppose the material is more plentiful in the areas without parking?

Burnt Mill Road Exit South of Pueblo, take exit 88 off Interstate 25 onto Pueblo County Road 246. The road cut is visible on the south side of the road, just at the end of the off ramp. There is a wide area for parking on the north side of County Road 246. This is not a huge road cut, but it is full of nice little clam and oyster fossils. Most are broken, but diligent searching should turn up some whole ones. There are also some interesting casts that look a lot like a beehive. If you know what they are, let me know. If you are in the mood, you can continue on down the road until you come to Little Burnt Mill Road. There are fossils along this road in both directions, but not as plentiful as back at the freeway.

Russell If you are on U.S. Highway 160 between Ft. Garland and Walsenburg (and if you are, you must be lost), you can find some small, but nicely detailed brachiopod and gastropod fossils in the shale of a large road cut. The cut is about a mile northeast of the abandoned town of Russell, which in turn is about 12 miles east of Ft. Garland. We haven't been there for a while, but when we were, an igloo-type building used as a highway shed marked the town of Russell. There was also an old log cabin off the road just west of the cut. You should have no trouble finding it, but even if you do, the scenery is beautiful all the way over La Veta Pass.

continued on page 24

The Wonderful World of Road Cuts *from page 22*

Perry Park To find some of the nicest satin spar around, just head for Perry Park and the really big road cut right across from the golf course. The trip starts at Sedalia, just south of the Denver area and only a few miles off Interstate 25. Leave I-25 at exit 183 and take U.S. Highway 85 to Sedalia. At Sedalia, turn south on state Route 105 toward Palmer Lake. At 14.4 miles from the turnoff to state Route 105, turn right onto Red Rock Road. Go .8 miles to Perry Park Road and turn right again. You can't miss the huge cut across from the golf course. By the way, there is a lot of alabaster mixed in with the satin spar for you carvers.

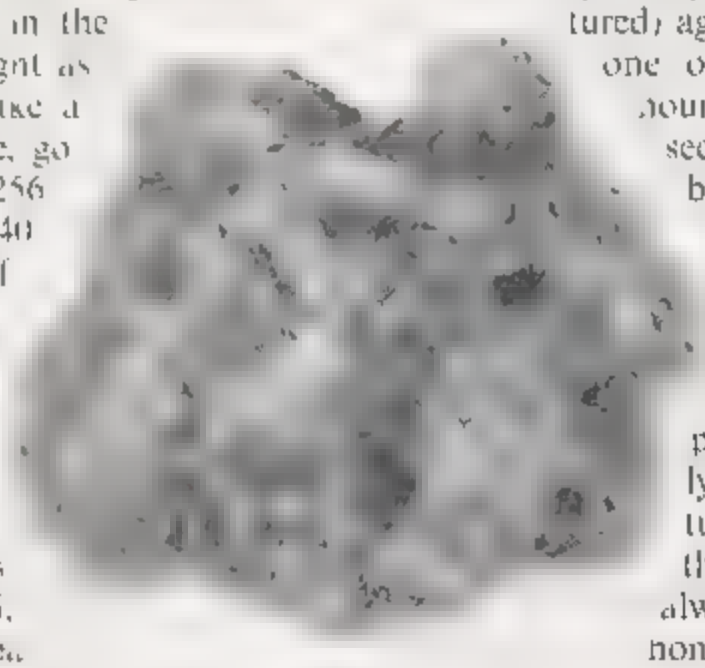
Genessee Dike This is a very old collecting area that is slowly being absorbed by civilization. It is on a section of U.S. Highway 40, just a skip and a jump from Interstate 70. Despite this, there is still a lot of interesting material here and if you are in the Denver area, you might as well run over and take a look. To find the site, go west on I-70 to exit 256. Take U.S. Highway 40 west for just over half a mile, and you will see the cut on the north side of the road. There is a wide parking area across from the cut, but the cut itself is very close to the road, so it is not a good idea to take small kids here. We found some pretty white feldspar with gray quartz crystals and black biotite mica. They make very nice display pieces. When you have your fill of collecting, you can visit Lookout Mountain and Buffalo Bill's grave. Life doesn't get any better than that.

Golden Gate Canyon There is a lot of pink feldspar with mica, and sometimes black tourmaline in the numerous road cuts along Golden Gate Canyon Road. To get to the best spots, drive north on state Route 93 from its intersection with U.S. Highway 6 and state Route 58 in Golden. At just about 1.5 miles from the junction, go left on state Route 46 (Golden Gate Canyon Road). At about 4 miles, you will begin to see flashes of mica in the road cuts. Look in all the cuts between here and Robinson Hill Road. There is a good place to pull out and park at Robinson Hill Road, and you can walk back to some of the cuts that were a little stingy with parking space.

UTAH

Cedar Canyon Southern Utah abounds with natural beauty and a host of national and state parks. Should you be on the way to see the spectacular Cedar Breaks National Monument, you can stop at a nice, wide pullout and find some oyster fossils in a little limestone road cut. To reach the site, leave Cedar City on state Route 14. About a half-mile from milepost 20, you will see a dirt road going right and a wide area where you can park. Look in the limestone boulders in the cut for the fossils. This is also a nice way to stop and stretch your legs before continuing up the twisting road to Cedar Breaks.

Brian Head After you finish absorbing the wonder of Cedar Breaks National Monument, you can drive a few miles down the road and pick up some very pretty (but usually fractured) agate. This area was one of our first rockhounding spots, and we seem to be drawn back here every time we are in the area. Agate abounds in the whole Brian Head area, but as the parentheses points out, it's usually pretty well fractured. It is so pretty, though, that we always take a little home and put it in the "rock garden." Lots of techniques can be used to turn Brian Head agate into jewelry, if that is your goal. One of the better ways is to make them into doublets or triplets. To find the road cut, drive north on state Route 148, past the visitors' center to the little dirt road that goes up to the observation point on Brian Head Peak. This is about 9.6 miles from state Route 14. Go 0.6 mile past the peak road and park in the wide area on your left. The big road cut is on your right, and it is full of big chunks of agate to cab-sized pieces.



There's a great site just off Interstate 70 in Colorado for collecting selenite specimens.

Kolob Road If you are on your way to or from Zion National Park along state Route 9, you can take a short side trip to a big road cut with some nice little peelecypod fossils. When you come to the town of Virgin, go north on Kolob Road for 18.5 miles to the cut. There is a big area to park in off the busy road. This is a good place for the kids, since it is well away from traffic to and from Kolob Reservoir.

Skull Rock Pass This is a site that can truly be said to be in the middle of nowhere. True, it is on a fine two-lane, paved U.S. Highway 50, but it is 47.8 miles from Delta, Utah, and 52.2 miles from Baker, Nevada. It's harder to get closer to the middle than that. By the way, there is nothing between the two towns but that ribbon of blacktop. No wonder U.S. Highway 50 is called "the loneliest highway in America." If you drive this road, you can relieve some of the boredom by stopping at the road cut at Skull Rock Pass. The cut is on both sides of the road and is a great place to find various Ordovician fossils in the gray shale. There are even some trilobites, but the chances of finding complete ones are slim. There are lots of identifiable pieces, though.

Sardine Summit Quite a few years ago, U.S. Highway 89/91 was widened at Sardine Summit. A lot of great black horn coral was found in the construction debris of the road cut. Unfortunately, by the time we got there, the area was pretty well picked over. There was a lot of blue-gray limestone with streaks of white quartz running through it. Most rockhounds would probably just leave it there, but I took some home and found that it worked up into nice cabochons. To get there, take exit 364 from Interstate 15 in Brigham City and follow U.S. Highway 89/91 for 10.3 miles to the big road cut. Keep your eyes open all along this route and beyond the summit. There are numerous road cuts, and who knows what treasures they might hold.

Guardsman Pass The sought after material here is specular hematite, and it is plentiful both in the high road cut and on the hillside down from the road. The site is at the end of the pavement and contains a big parking lot, since this is a trailhead for hikers. Park and walk a few yards down the dirt road. The cut is on the left, but as I said, the downhill side has a lot of material, too. To get there, go up Big Cottonwood Canyon to the Brighton turnoff. Go left toward Guardsman Pass, and in about 3 miles, you will be at the site. Don't forget the camera on this one, since the view is spectacular.

Wah Wah Mountains These are highly mineralized mountains containing a wide variety of material that is of interest to the rockhound. If you take state Route 21 west out of Milford to milepost 46, you will be within a half-mile of a road cut through some of this mineralization. The cut itself is not exactly a treasure house, but it will give you a general idea

continued on page 38

of what is in the area. We did find some nice mica samples in the cut, and some unidentifiable (to us) mineral specimens. This is another lonely road like U.S. Highway 50, but I'll bet if you stay on it for a few more miles, you will come to even more road cuts. Maybe they will be more productive.

Fossil shells were found at Wolf Creek Dam in Kentucky.

NEVADA

Old Highway We came up with this really clever name for this site, because it is along an old highway. To find it and the nice selenite samples found there, drive south from the intersection of U.S. Highway 50 and U.S. Highway 95A in Silver Springs, west of Fallon. Go 13.9 miles along this road, then look for a dirt road going east. Take this road for about 0.3 mile to the old highway. We haven't been to this site for quite a while, and when we were, it was a pretty rough 0.3 mile, requiring at least a high-clearance vehicle. When you get to the old highway, turn left and drive about 1.5 mile to a long road cut. This is your goal. The old highway is just the remains of a blacktop road, so it is reasonably smooth.

State Route 34 Road Cut This is another dirt road, but when we were there a few years ago, it was the best dirt road I'd ever been on, bar none, and we've been on a lot of dirt roads in our time. When we first entered it, though, a sign warned that it was not maintained and travelers used it at their own risk. These are not comforting words in the middle of nowhere, but they turned out to be totally wrong. It was obvious that the grader had been there very recently, and we sailed along the whole 50 miles or so as though we were on a freeway, but with no other traffic. To get to the road cut, start in Cedarville, California, and drive east on state Route 299 (which becomes state Route 8A at the Nevada border) for 20 miles to state Route 34. Follow state Route 34 south for 27.5 miles to a long road cut on the left. Here you will find fluorescent chalcedony, bubbly chalcedony in several colors mixed with clear and white, and even a few pieces of amethyst-colored agate. On the other side of the road, there are some nice obsidian nodules.

Major's Place Just northwest of the junction of U.S. Highway 50/6 and U.S. Highway 93, there is a long (about 2 miles) road cut with a lot of calcite, a lot of traffic, and very little parking. We stopped there because we had been told that the calcite would fluoresce. Well, we lugged a bunch home, but no dice. There is so much there, though, that maybe some of it really does fluoresce. The site is certainly easy to get to and the calcite is pretty in its own way.

Mason Pass Road Here is a fairly easy spot to get to on a good dirt road. There are nice display specimens of azurite stains on a dark matrix. A lot of turquoise has been found in this area, but we weren't so lucky. Maybe you will be. To reach the site, start in Yerington and drive north on U.S. Highway 95A to Luzier Lane. Go left on Luzier Lane for just over 2 miles to the intersection with Mason Pass Road. Turn right on Mason Pass Road and go 3.7 miles to a cut on the left.

This is just a sampling of what awaits you in the Wonderful World of Road Cuts. If you live in or near one of the states above, maybe you can take advantage of some of the sites. Of course the real fun of this hobby is finding a new site for yourself. Watch for road cuts wherever you drive, and one of these days you may discover the mother lode of road cut treasure. In any case, you will have fun, you will find interesting material, and you will not have to have four-wheel-drive or go miles and miles into nowhere—unless you want to.

DR. JOHN SINKANKAS MEMORIAL EDITORIAL AWARD

John Sinkankas was, without a doubt, one of the great researchers and writers of mineral and gem books and articles. His passing in 2002 generated an outpouring of unsurpassed praise from all over the world.

Writing an eulogy to John doesn't seem quite enough to recognize all he has given to us, so the staff of *Rock & Gem* has decided to create a John Sinkankas memorial editorial contest. Each year, one article that appears in *Rock & Gem* will be recognized with this award.

CONTEST RULES

1. Readers will select the winning article by vote, using the form printed in every issue of *Rock & Gem*.

2. The only criteria will be the judgment of the readers as to how useful, informative and enjoyable the article is.

3. Contributing editors and employees of *Rock & Gem* are not eligible for this award.

4. The winning writer will be asked to submit a photo so he or she may be recognized in an issue of *Rock & Gem*.

The writer of the winning article will receive a one-year subscription to *Rock & Gem* and a certificate of merit for the winning entry.

VOTING FORM

Title of article

_____

Issue in which the article appeared

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Name of the writer

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Reasons for choice

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Mail ballots to Dr. John Sinkankas Memorial Editorial Award
P.O. Box 6925, Ventura, CA 93006-9839

LAPIDARY LORE and MORE

by June Culp Zeitner

Dreams Do Come True

In 1969, my late friend Jean Dahlberg, a member of the Minnesota Mineral Club, met with legislators to lobby for the passage of a bill to make Lake Superior agate the state's official gem. This distinctive and popular agate was the choice of Minnesota citizens.

The bill passed easily, much to the delight of the Carlton County Gem & Mineral Club, whose hometown, Moose Lake, had become the acknowledged capital of Lake Superior agates. Not only were the bright banded agates abundant there, some of the largest ever found came from Moose Lake, including one that topped 100 pounds. The Moose Lake Commercial Club knew the mineral club was onto a good thing when it started planning an annual Agate Days celebration instead of a show, so the Commercial Club joined in planning and hosting the annual event, which became important to the city, the county, and rockhounds from everywhere.

An event that has always drawn unbelievable crowds is the Agate Stampede. A truck loaded with gravel liberally salted with donated "takers" dumps its treasure pile for eager collectors. "Stampede" is a good name for what ensues.

In the late 20th century, tons of agates were destroyed in gravel crushing operations and many collecting sites were closed to agate lancers. In 1987, the Rev. Paul Gotsch, an avid agate enthusiast, started dreaming about a rockhound state park near Moose Lake where agates could be collected, saved, documented, and interpreted. He contacted the Minnesota Department of Natural Resources (DNR) and was encouraged to see what he could do.

This started an almost endless chain of letters, phone calls, and meetings. Phil's first dedicated partner was Scott Wolter, author of *The Lake Superior Agate*. They spent countless hours meeting with individuals and small, large and huge groups to extol the wonders of agates, the beauty, the geologic history, the quest, and how the state could benefit from promoting this mineral kingdom heritage. In 1989, the Minnesota Legislature directed the DNR to undertake a feasibility study of the Moose Lake proposals. In addition to Rev. Gotsch, Wolter and the Carlton County club, the Minnesota Mineral Club and the Anoka County Gem & Mineral Club were now on board.

Things began to get in 1997, when the legislature appropriated $75,000 for a design process for a Minnesota geology interpretive center, featuring Lake Superior agates, to be located at Moose Lake State Park. The design team included architect Chuck French, Rev. Gotsch, Wolter, Michael Carlson (author of *The Beauty of Banded Agates*), park manager Mark Tuschen, geologist Dr. Connie Sansome, DNR naturalist Ted Sheppard, and Dr. Dave Southwick, Director of the Minnesota Geological Survey.

In addition to a world-class agate display, the new building would house an illustrated geological history of the state. Minnesota went through periods of primordial volcanism and has some of the oldest rock in United States. The state was also visited by both the Laurentide and Cordilleran ice sheets.

Already, many donations of top-quality agates have been pledged. In 2001, the Legislature appropriated $1 million to start construction. The groundbreaking attracted happy crowds on Apr. 6, 2002, and the Grand Opening was the highlight of Moose Lake Agate Days 2003. To those who worked on it for so many years, it is a dream come true.

Such a project does much more than add a new museum to a state with a rich cultural heritage. For one thing, working together has enlarged and strengthened the clubs. It has given new knowledge to residents and visitors, and it has helped the economy of a predominantly rural area. The center has proved that a great idea can get city, county and state politicians working together with constituents to accomplish things that at one time might have seemed impossible. The work of these clubs has called the attention of many thousands of people to the mission of our clubs and our hobby.

Lake Superior agates are not limited to Minnesota by any means. I have found a few in northeastern South Dakota, in Illinois, Michigan and Wisconsin, and a pal fish in Muscatine, Iowa. Agates are also found in Kansas and Missouri, in fact Rev. Gotsch says some magnificent Lake Superior agates found near Topeka, Kansas, are a recent donation to the Moose Lake Park Interpretive Center.

The annual Agate Days event at Moose Lake draws more people each year. There are exhibits, dealers, swappers, field trips, special events, and sometimes book signings by area authors Wolter and Carlson. There are excellent campgrounds, delicious food, and pleasant summer days. (Northern Minnesota's summer climate near Lake Superior is one of the nation's best.)

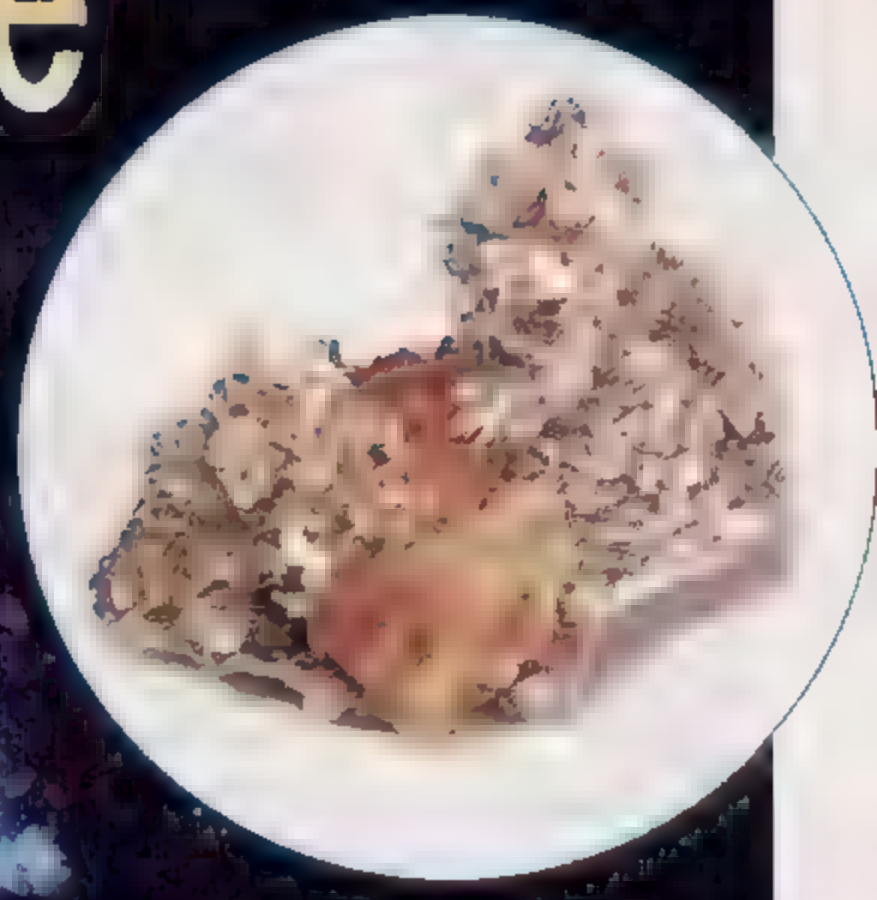
The cooperation of government branches and civic organizations with gem and mineral clubs or rockhounds in general, is not new. For many years, the lovely city of Spruce Pine, North Carolina, hosted a quality show with great exhibits, top speakers, exciting field trips, and the best food of any show I ever attended. Gordon, Nebraska, used to host shows, and Crawford, Nebraska, helps with the annual Fairburn show.

A park dedicated to a gem or mineral has also occurred before. An example is Flint Ridge State Park in Ohio, where a museum interprets the geology and history of this notable deposit of colorful flint, the prime source of material for projectiles and tools of many early tribes of Indians. The park was a government project, however. Iowa has a Geode State Park, the Smiths of New London (Geode Industries) were active in promoting it. Arkansas has Crater of Diamonds State Park. New Mexico opened Rockhound State Park, an enormous collecting area, in June 1966. Virginia's Fairy Stone State Park honors the plentiful staurolite crystals. There are national parks honoring gems or minerals. Arizona's Petrified Wood National Park and Michigan's copper-country Keweenaw National Historical Park.

None of these were brought about by a few inspired and hard-working club members and the few sponsoring clubs, which makes the Lake Superior agate achievement even more amazing. Wouldn't it be wonderful if North Carolina had an emerald or ruby state park and Montana had a sapphire state park? There's room in Nevada for an opal or turquoise state park, and Oregon could have a thunder egg or maybe obsidian state park. And while I'm at it, why not a Fairburn agate state park in South Dakota? If Minnesota clubs can make their dreams come true, other clubs can, too. What a great thing it would be for our hobby and its mission, which is the education of the public and future generations about the wonders of the earth sciences.

Fluorescent Scheelite and Powellite

Ultraviolet Light Reveals Their Hidden Beauty



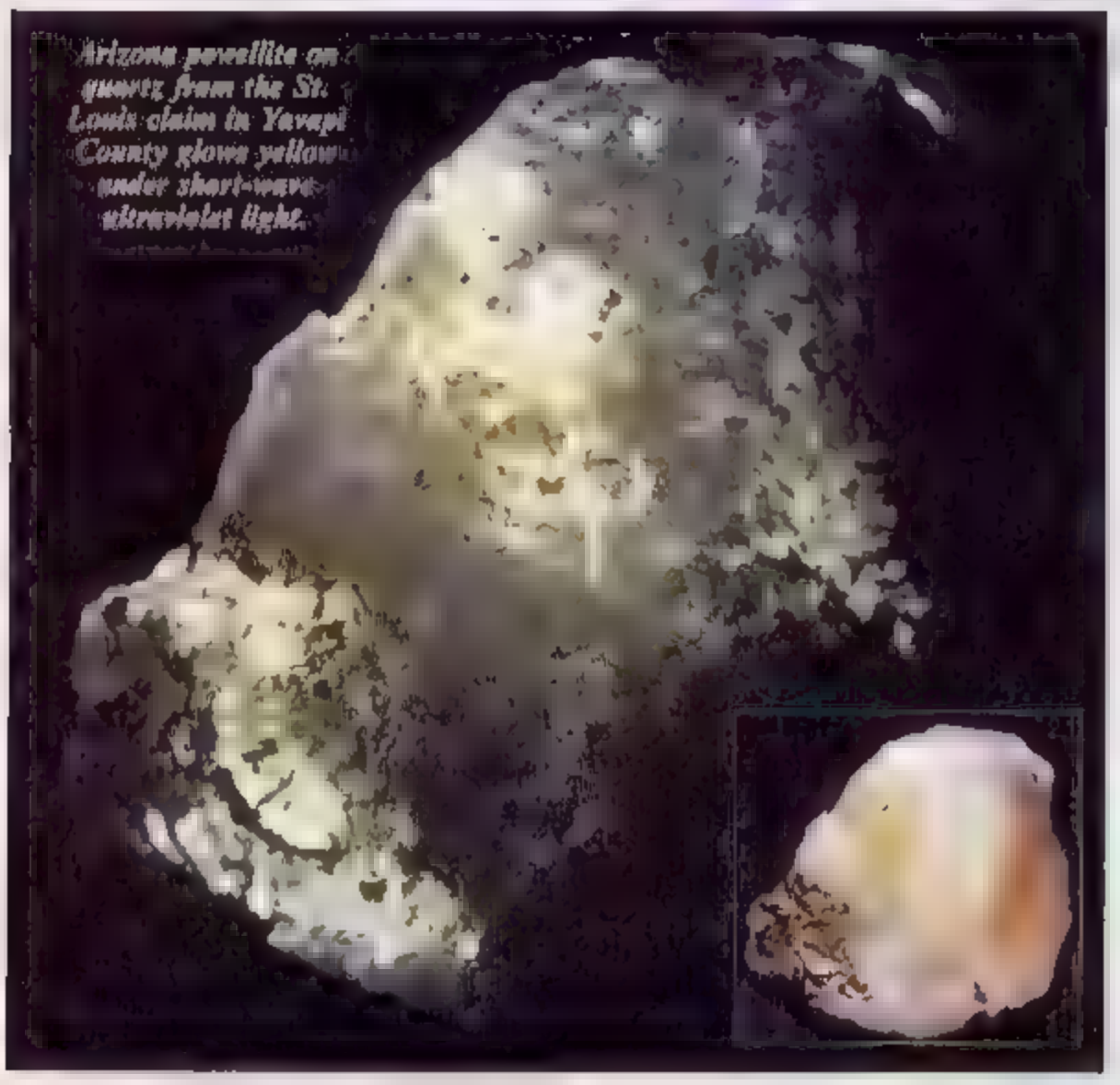
Some of the biggest and most attractive scheelite crystals have come out of lower-central China in recent years. (Photos by the author).

by Stuart Schneider

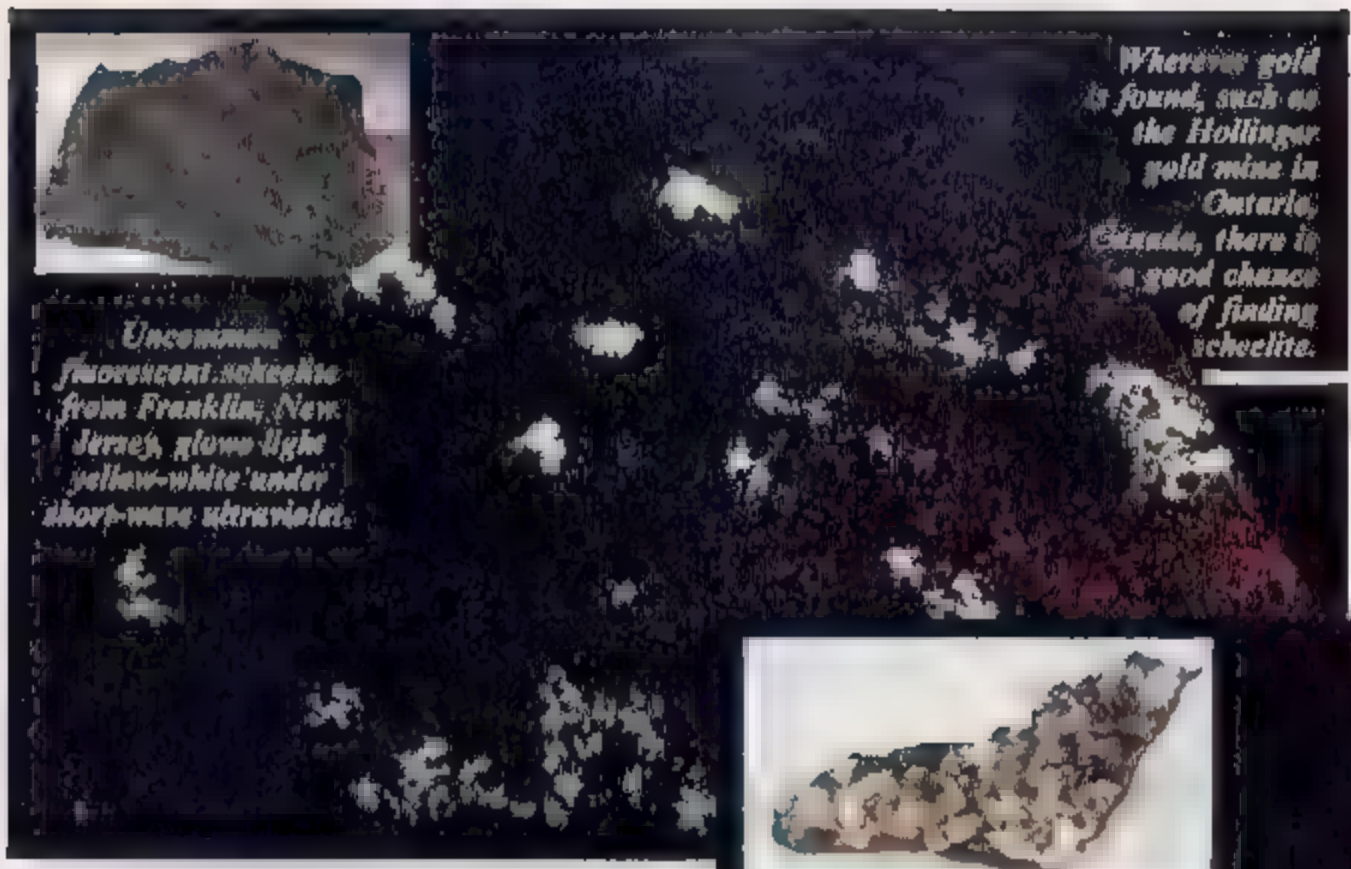
Collecting scheelite and powellite may sound pretty entertaining, but I think that the real fun of these two minerals is seeing their fluorescence under shortwave (SW) or longwave (LW) ultraviolet (UV) light. Scheelite is the primary ore of tungsten. It is a calcium tungstate ($CaWO_4$). Powellite is closely related to scheelite. It is a calcium molybdate ($CaMoO_4$).

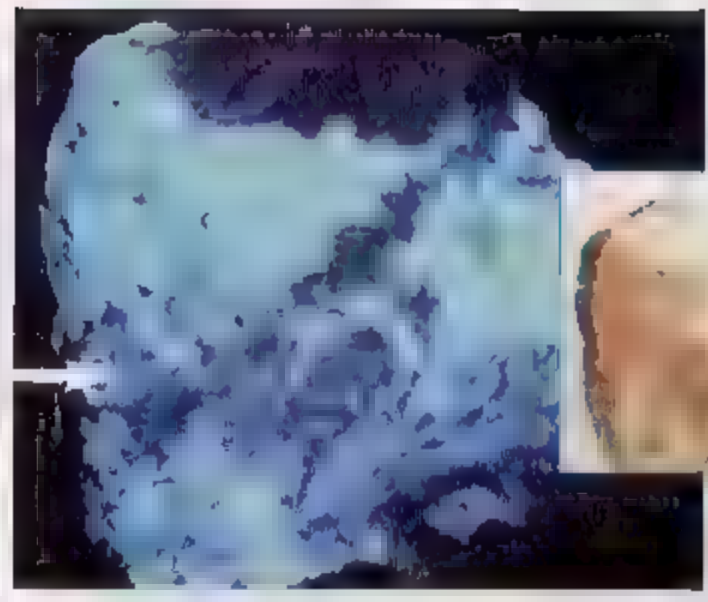
Scheelite is a popular mineral for collectors. It forms perfect tetragonal dipyramidal crystals that look very much like octahedrons. (A dipyramid is two four sided pyramids joined base to base.) These crystals are sometimes truncated with pyramids, but only on the top and/or bottom of the crystal. Scheelite commonly occurs as compact or granular masses in contact-metamorphic deposits, especially limestone invaded by granites, in granite pegmatites, and in quartz veins. Its color is brown, tan, golden-yellow, or cream, and its luster is vitreous, and occasionally gemmy and transparent. Its hardness is Mohs 4.5 to 5, making it a soft mineral for lapidary use, although faceted gems have been cut from some gemmy Chinese material.

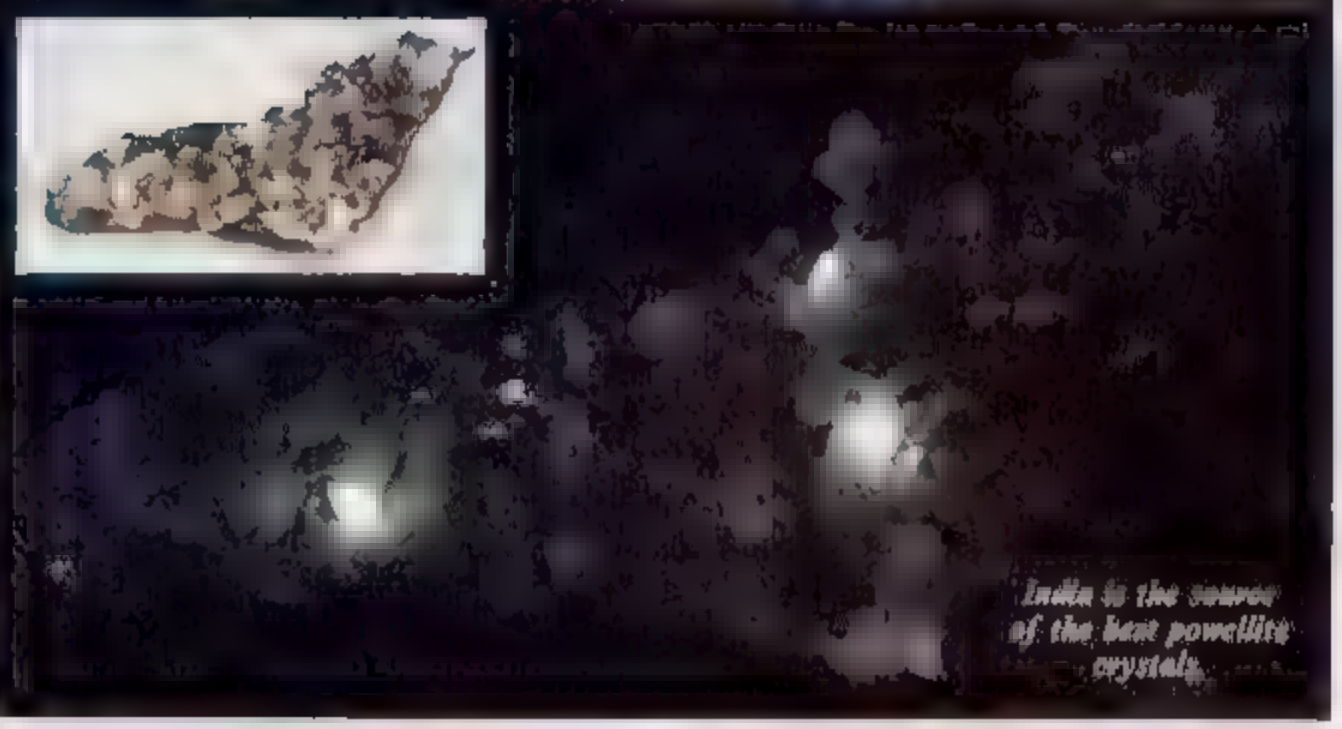
Powellite was named after the American geologist Major John Wesley Powell (1834-1902), a former director of the U.S. Geological Survey. The first reported find of powellite was at the Peacock Claim in the Seven Devils District of Adams County, Utah, in 1891. Powellite fluoresces yellow-white to yellow under SW and LW. It has a hardness of Mohs 3.5 to 4, and its luster is adamantine or resinous.



Arizona powellite on quartz from the St. Louis claim in Yavapai County glows yellow under short-wave ultraviolet light.



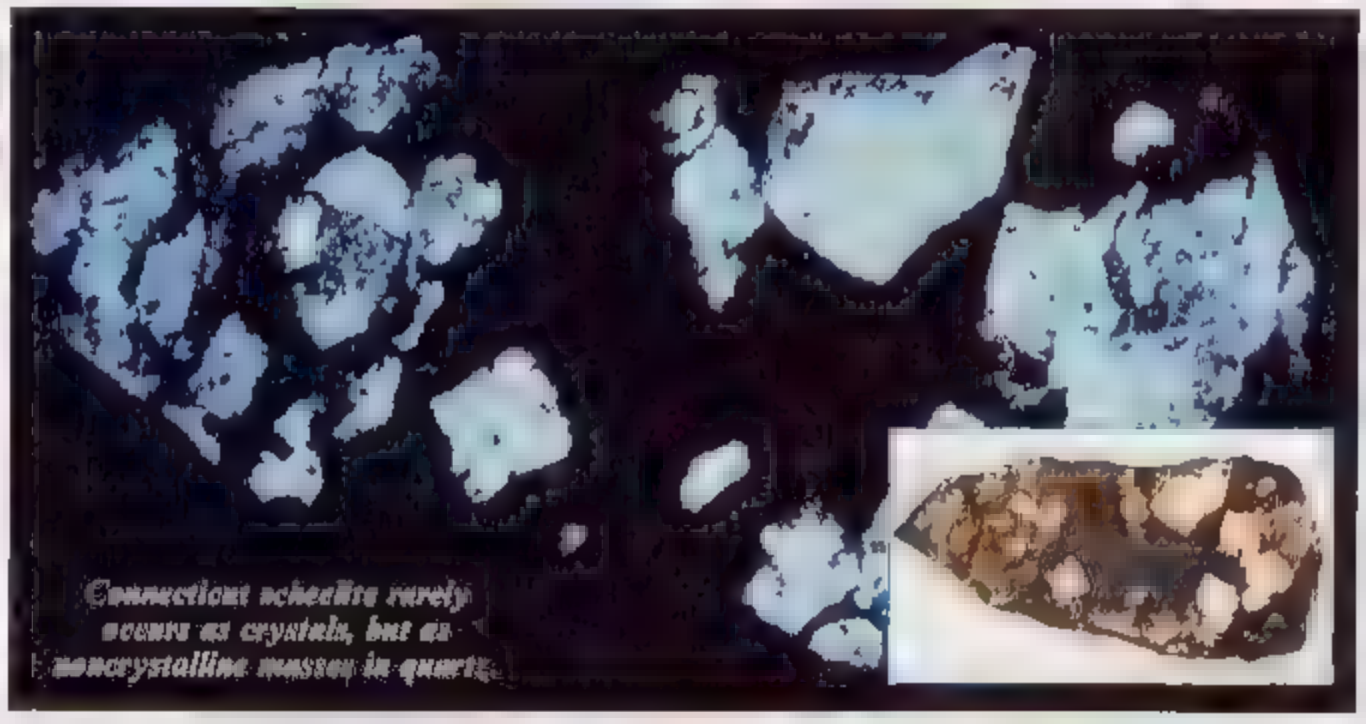


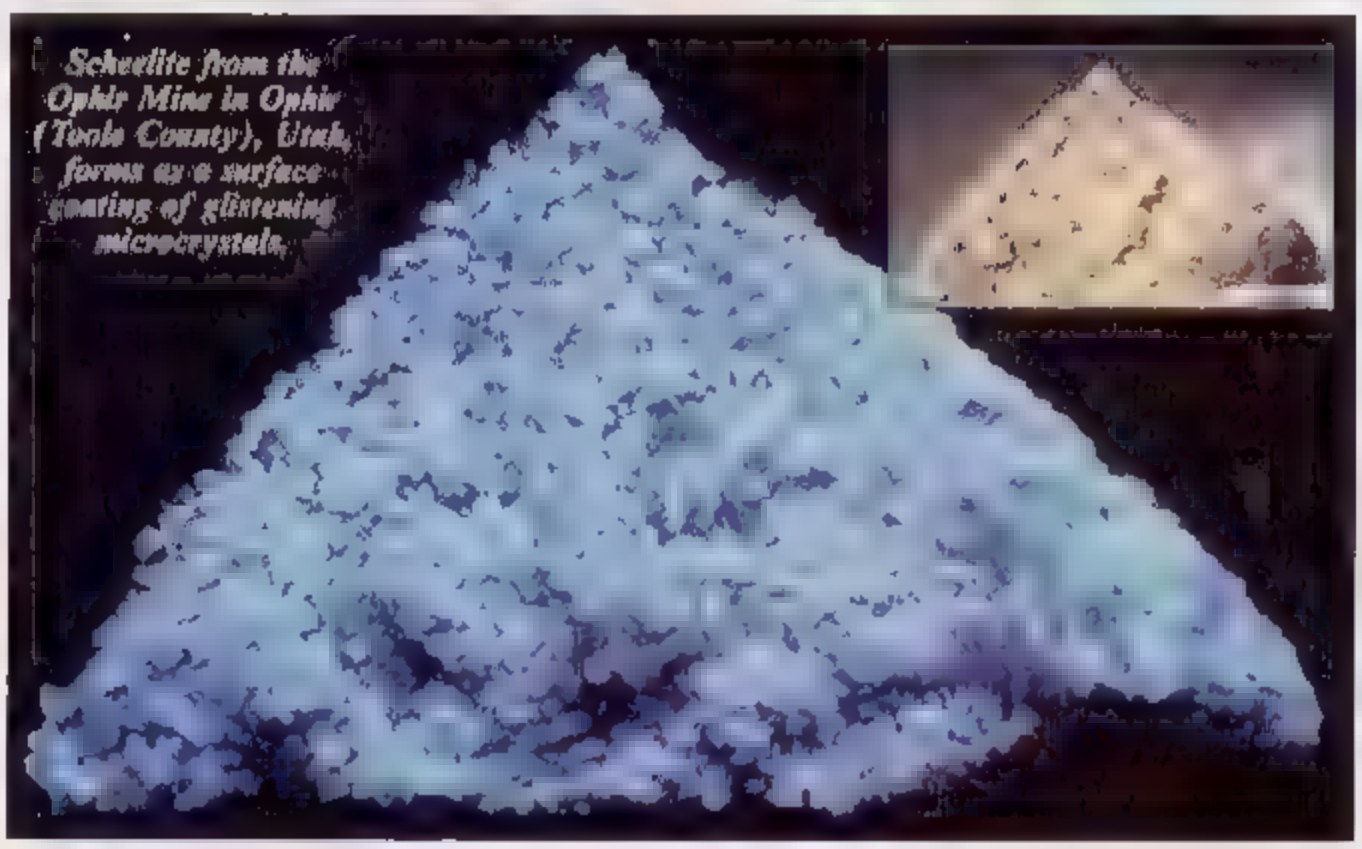


Scheelite and powellite are both bright fluorescents, with scheelite being the brighter of the two and the more commercially valuable. The search for U.S. sources of scheelite is actually responsible for the popularity of the portable SW UV light used by most fluorescent mineral collectors. Once this portable UV light became available and collectors found out what it could do, it became the catalyst that started the hobby of collecting fluorescent minerals.

Before our involvement in World War II, much of the tungsten used in the United States came from Chinese scheelite. Without tungsten, our metal workers were forced to use molybdenum steel drill bits and metal-working tools, which wore out quickly. One tungsten carbide drill bit would last 20 times longer than a molybdenum steel drill bit. Our government, anticipating a tungsten shortage because of the war in Europe and increased danger to ships carrying strategic supplies to the United States, encouraged the mining industry to find U.S. sources of scheelite.

It was believed that scheelite deposits could be found throughout the western United States, even though the earliest U.S. scheelite mines were in Connecticut. Prospectors began to look for scheelite, but unfortunately, it looked just like quartz, a very common western rock. Ultra Violet Products, a small California company, was one of the only companies that made portable UV lights. Since scheelite glows under SW UV, one of these lights would enable miners to locate scheelite in the field. It turned out that scheelite often occurs in conjunction with gold quartz. As miners fanned out across the West, they found that many exhausted gold mines' tailings glowed bright blue-white and were full of scheelite. These exhausted gold mines were once again valuable mining properties. U.S. sources of scheelite were found in abundance, and during the war years there was no shortage of tungsten and tungsten carbide tools.





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Fluorescent Scheelite and Powellite *from page 29*

Another obstacle to scheelite mining was that scheelite is often found with impurities in it. The major impurity is molybdenum, which makes extracting the tungsten troublesome. As the amount of molybdenum in the scheelite increases, the color under SW U.V. changes from blue-white (under 1 percent) to white (about 1.5 percent) to yellow (10 percent). The cost of refining the ore goes up as the percentage of molybdenum goes up. This SW color variation was useful to miners looking for tungsten ore. A card was once available that contained nine samples of scheelite with different percentages of molybdenum. There were holes in the card next to each sample. A miner could hold his piece of ore up to the card under SW U.V. light and compare the purity of the scheelite sample to the known percentages on the card. This enabled the miner to determine in the field whether the ore was pure enough to warrant further mining.

Powellite forms similar crystals to scheelite. They share a comparable structure. The two minerals form a series in which the tungsten of scheelite is substituted for the molybdenum of powellite. Since molybdenum can substitute for tungsten, some scheelite will show a yellow fluorescence under LW U.V., pure scheelite is pretty dead, fluorescently speaking. As the molybdenum content increases, it will show a yellow response under LW U.V.

Did you know that tungsten, as it is known as in the Americas, is called wolfram in Europe? Its chemical symbol, W, was derived from the name wolfram. By the 1500s, Saxonian tin miners knew that there was a heavy unknown ore that, when added to tin ores in refining, reduced the tin yield. Refiners said that it was as if something ate up the tin like a wolf eating a sheep. They called the tin eating ore "Geifer of wolves" or "wolf cream." It eventually was named wolfram because it ate tin like the wolf and produced a dirtlike tin impurity. "Rahm" is the German word for dirt.

In 1751, the Swedish chemist and mineralogist Axel Fredrik Cronstedt (1722-65) was working with a heavy mineral, which he named "tungsten." This mineral was actually scheelite. Pure scheelite crystals, with a specific gravity of 19.3, are very heavy for their size. Cronstedt assumed this was a new element, but he could not separate the metal from the mineral.

Scheelite was named for one of its original discoverers, a Swedish chemist named Karl Wilhelm Scheele (1742-86). Scheele was born in Pomerania, Germany, but spent most of his life in Sweden working as a pharmacist. He was a self-taught chemist who is also credited with discovering oxygen in 1772-73. In 1781, Scheele wrote that scheelite was a compound of lime and an acid, which he called tungstic acid. Scheele suggested it was possible to obtain a new metal by reducing this acid. In hindsight, it may have actually been more appropriate to name the mineral "scheelite" since it was at Bergara, Spain's first research institute, that the metallic form of tungsten was first isolated from tungstic acid. This was achieved in 1783 by the brothers Fausto de Elhuyar (1755-1833) and Juan Jose de Elhuyar (1754-96). Scheelite suffered along with its misnomer, tungsten, for many years. It was not until 1821 that the mineral was actually named scheelite by C.C. Leonhard, a scientist studying metals.

In the United States, scheelite is the main source for tungsten. In Europe, wolframite, a related mineral, is usually the main source for tungsten. Tungsten acquired commercial value in the 20th century when tungsten began to be used to harden steel (tungsten carbide) and was made into electric-light filaments. Thomas Edison originally used carbon

filaments in his earliest light bulbs, but they burned out quickly. He needed a material that could "burn" brightly, but not melt. Tungsten, which could be drawn into a very thin wire, was the perfect choice. Pure tungsten is a steel gray to tin-white metal and has the highest melting point of all metals, 3,410 degrees Celsius. At temperatures over 1,650 degrees Celsius, it has the highest tensile strength of all metals. It also has excellent corrosion resistance.

At its purest, scheelite fluoresces a bright blue-white. Scheelite is a "self-activated" mineral. Its fluorescence is due to the mineral itself, rather than an activator. Calcite is generally not fluorescent, but add a tiny amount of manganese and an even smaller amount of lead, and the calcite will fluoresce bright red-orange under SW U.V. The manganese and lead are co-activators.

Fluorescence is a physical process. Light (which is electromagnetic radiation) of one wavelength, strikes a fluorescent mineral and causes light to come out of that mineral at another, longer wavelength. When those wavelengths reach the visible spectrum, we can see the different wavelengths as different colors. SW lights give out light in the 254 nanometer range. (Nanometers are a measure of the length of the light wave.) LW is produced in the 350 to 370 nanometer range.

When one thinks of fluorescing minerals, they first think of the "standard" in fluorescent minerals, willemite (bright green under SW U.V.) and calcite (bright red-orange under SW U.V.) from the Franklin, New Jersey, area. Scheelite and powellite though rare, are present among the approximately 86 fluorescent minerals found at Franklin. Franklin scheelite glows yellow-white under SW U.V. and is usually sparsely populated on a dark matrix. Powellite from nearby Sterling Hill is usually found as a few individual blebs on a very hard amphibole matrix, often containing fluorescent fluorapatite. The Sterling Hill powellite glows yellow-white under SW and LW U.V.

The first U.S. mining of scheelite took place in Connecticut. This scheelite rarely appears as crystals. Most U.S. scheelite is made up of smaller crystals or nonerystaline masses in quartz.

Moving west, we can find scheelite in California, New Mexico, Arizona, and Utah. The most interesting pieces have several additional fluorescent minerals such as chalcedony (generally green), hyalite opal (green), calcite (yellow), and aragonite or hydrozincite (both blue-white).

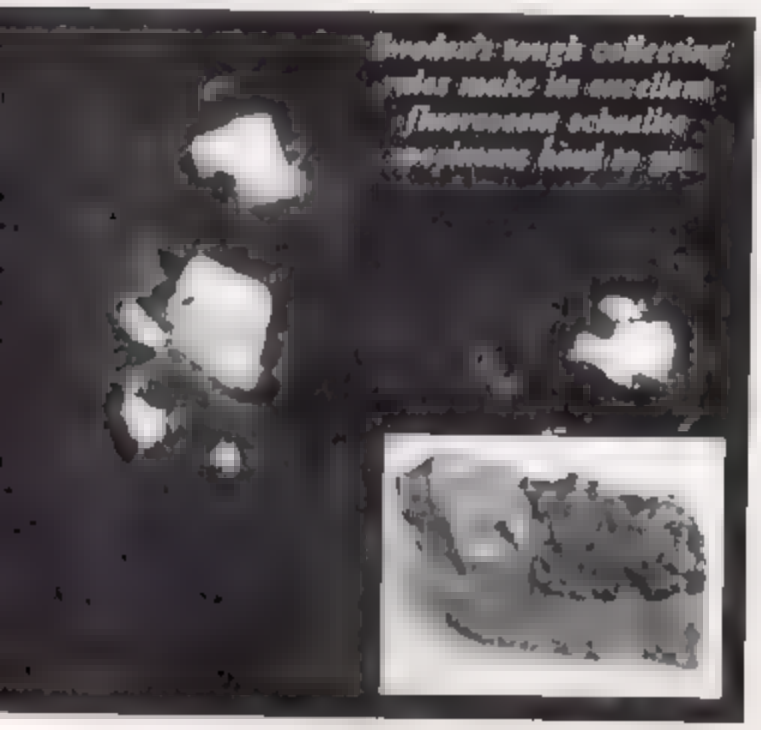
The best examples of large scheelite crystals come from China. The largest weigh several pounds and may sit in a bed of muscovite mica. Some newer material from a different location in China is embedded in fluorite and may have beryl crystals growing alongside the scheelite crystals.

Interesting scheelite examples can be found from Korea, Japan, Italy, Canada, and Sweden. Powellite can more often be found in mines in the western United States, where the crystals are small or the powellite is massive. Currently, the finest large (1 inch to 2 inches) powellite crystals are coming out of India and are often mixed in with stilbite or scolecite. Generally, they sell for $300 to $2,000 for the nicest examples.

If you are lucky enough to live in the western United States near old gold mines, checking the tailings of these mines can often turn up some scheelite in the quartz. There are still a few road cuts and mine dumps in Connecticut that can produce some wonderful massive scheelite in quartz.

At the 2004 Tucson Gem & Mineral Show, a substantial quantity of material was available from the dealers from Pakistan, India and China, exceptional material that rarely shows up at local rock and gem shows. Local rock shows can still be an excellent source of material, though. The dealers occasionally obtain pieces from old collections that came from mines that are no longer in operation. Checking these dealers' stock with a SW UV light can be an exciting and rewarding experience. Just remember that SW U.V. generally does not penetrate plastic, so scanning the closed boxes with your light will not show what you are looking for.

For more information on fluorescent minerals, visit my 10-page online Fluorescent Mineral Museum, www.worderatt.net, with links to mineral light, museum, dealer, and collector organization Web pages.



GOLD AND GEM HIGHWAYS

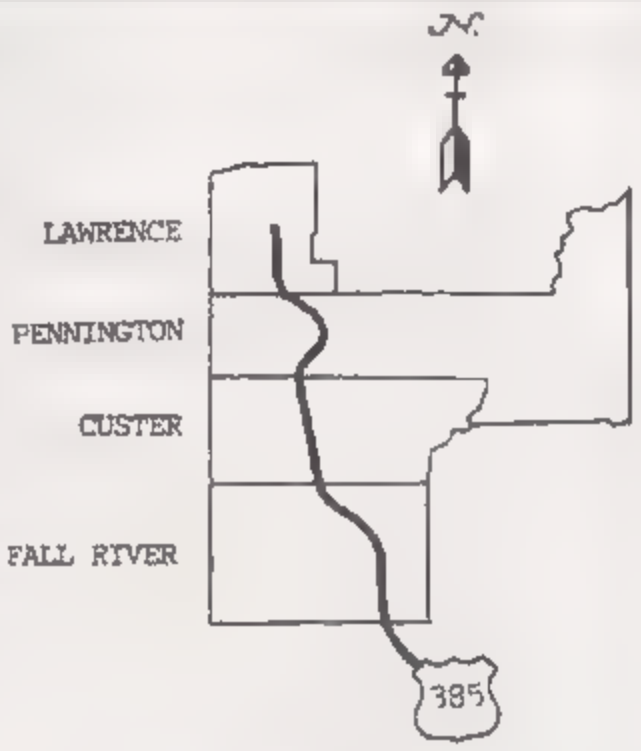
PANNING SITES ALONG U.S. HIGHWAY 385

Spots in South Dakota to Try Your Luck

by David and Clois Walker

Too many times, on the way to grandma's with the family for instance, we're haunted by all those attractive highway stream crossings along the way. With all those hilltops in the background, who can deny the possibility of mineral-bearing sand and gravel having accumulated right there under the bridge?

By way of ascertaining the nature and extent of such possibilities along U. S. Highway 385 in South Dakota, with the Black Hills looming in the background, we've plotted the locations of surface-oriented placers reported by the Geological Survey and others on a state-wide shaded relief map. Surprisingly enough, a number of the locations proved to be on watersheds intermittently crisscrossed by U.S. Highway 385 in four counties.



In this listing, we have included the minerals and gems previously reported to have been found in the vicinity of the various highway/stream crossings along U. S. Highway 385.

Panning at highway/stream crossings does not require the rockhound to obtain permission from landowners. However, he should observe the usual safety and environmental regulations, particularly regarding traffic and the disturbance of highway embankments. Using only a pan and scoop rarely presents a problem.

Following the location and vicinity finds listings, then, we have provided corresponding county-by-county maps on a proportionate scale and in sufficient detail for referral to the official state highway map for overall orientation in the field.

Even where an overabundance of surface-oriented gem and mineral deposits have been reported upstream from the highway crossing, we cannot guarantee your success, but you have a sporting chance of finding gold or gems.

LOCATION AND VICINITY FINDS ALONG U.S. HIGHWAY 385 IN SOUTH DAKOTA

Fall River County (Map SD1)
Site 1. Crossing on Horsehead Creek, near OELRICHS. Vicinity finds include agate, chalcedony, jasper, and silicified wood
Site 2. Crossing on Cheyenne River, near HOT SPRINGS. Vicinity finds include agate, jasper, opalized wood, and silicified wood

Custer County (Maps SD2-3)
Site 1. Crossing on Beaver Creek, near PRINGLE. Vicinity finds include agate and quartz crystals.
Site 2. Crossing on tributary of Stockade Lake, near CUSTER. Vicinity finds include garnet and quartz crystals.

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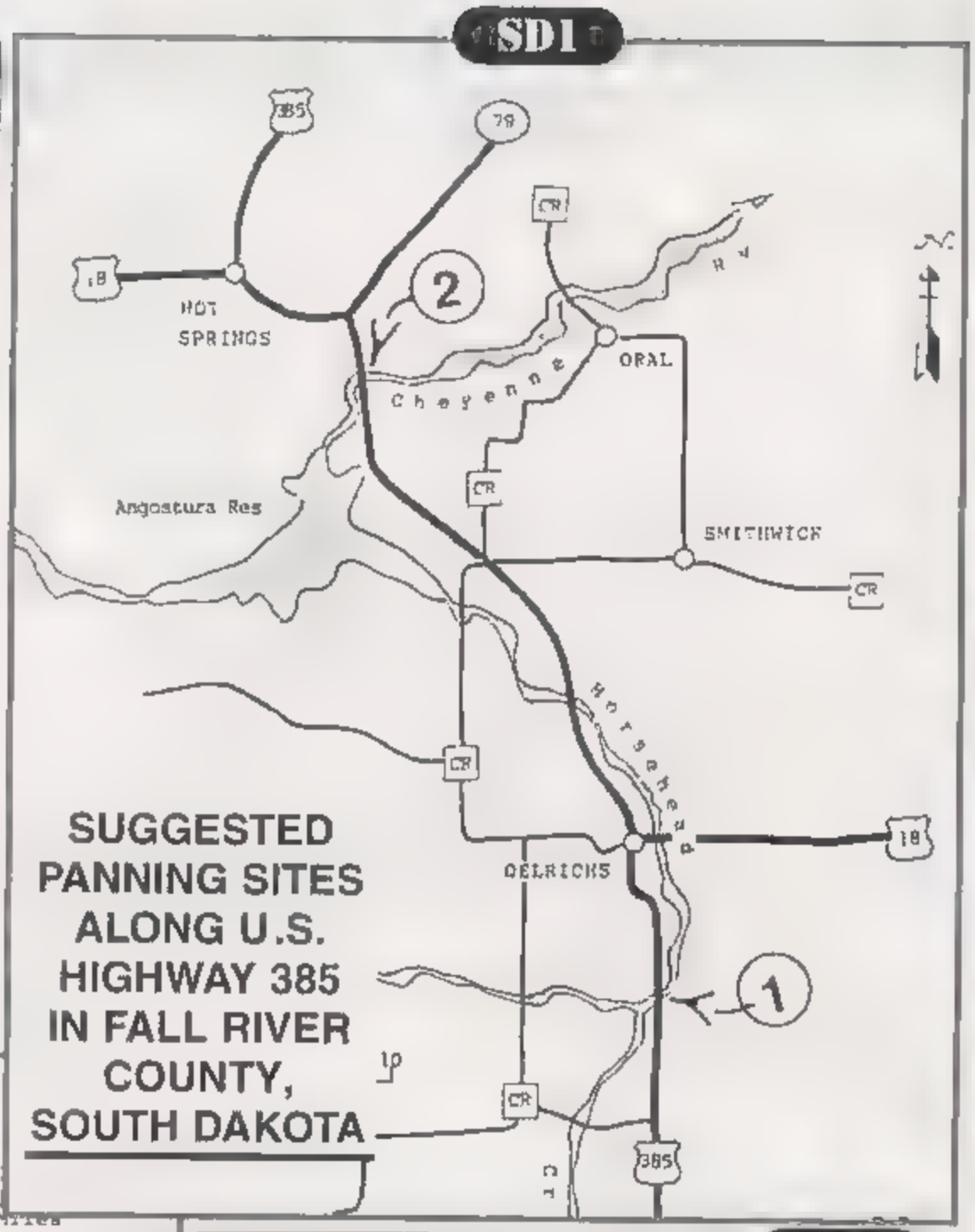
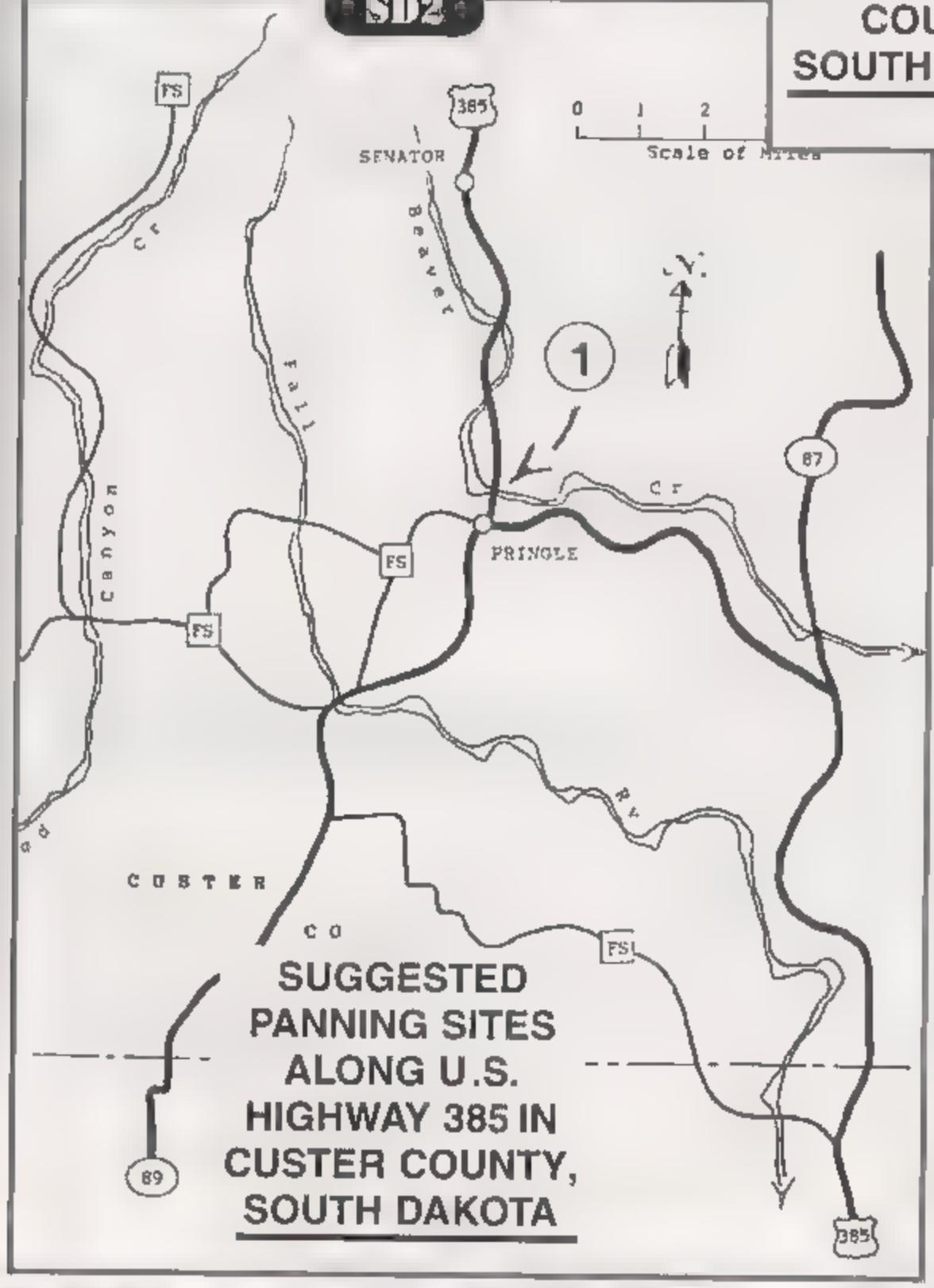
SD1



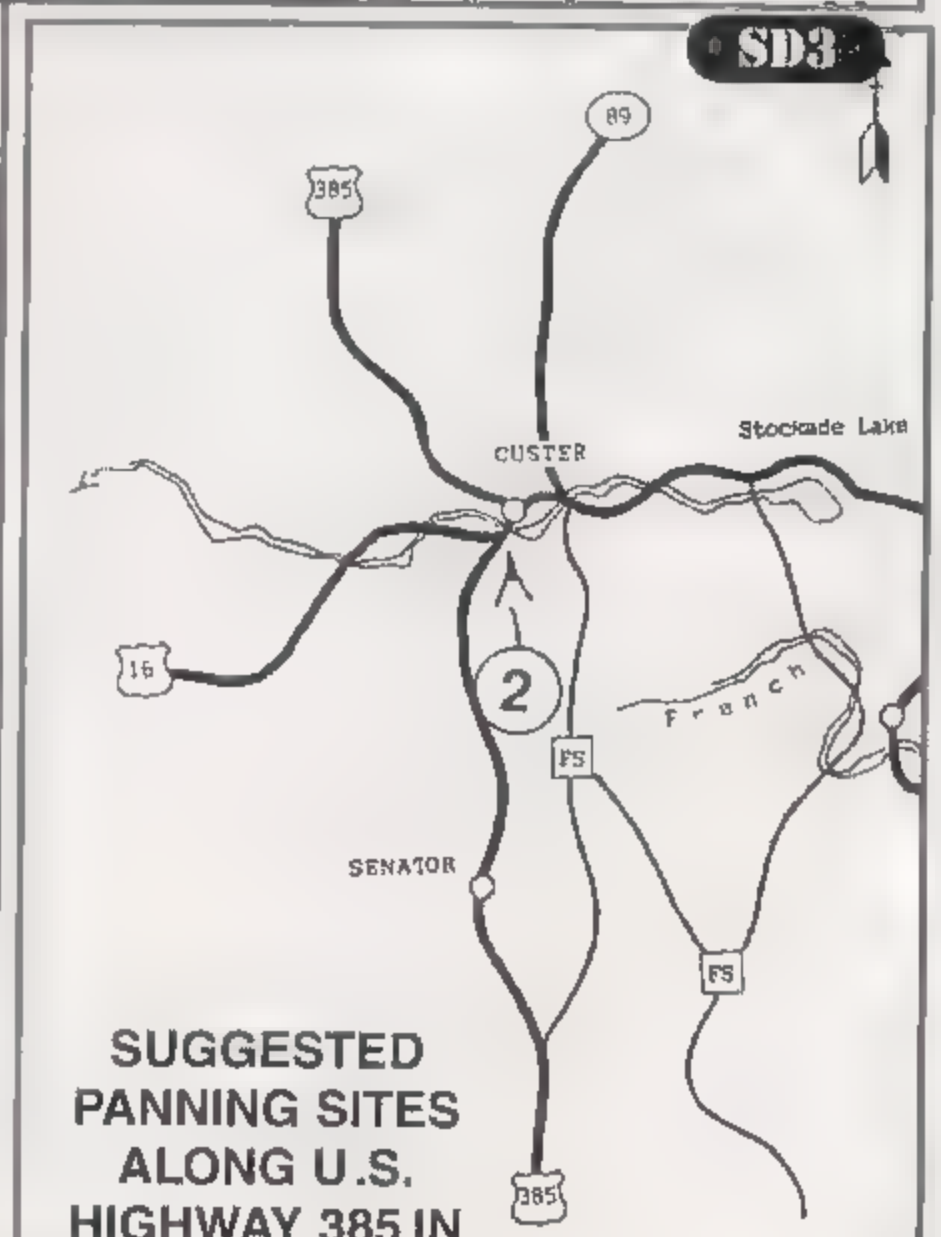
SUGGESTED PANNING SITES ALONG U.S. HIGHWAY 385 IN FALL RIVER COUNTY, SOUTH DAKOTA

SD2



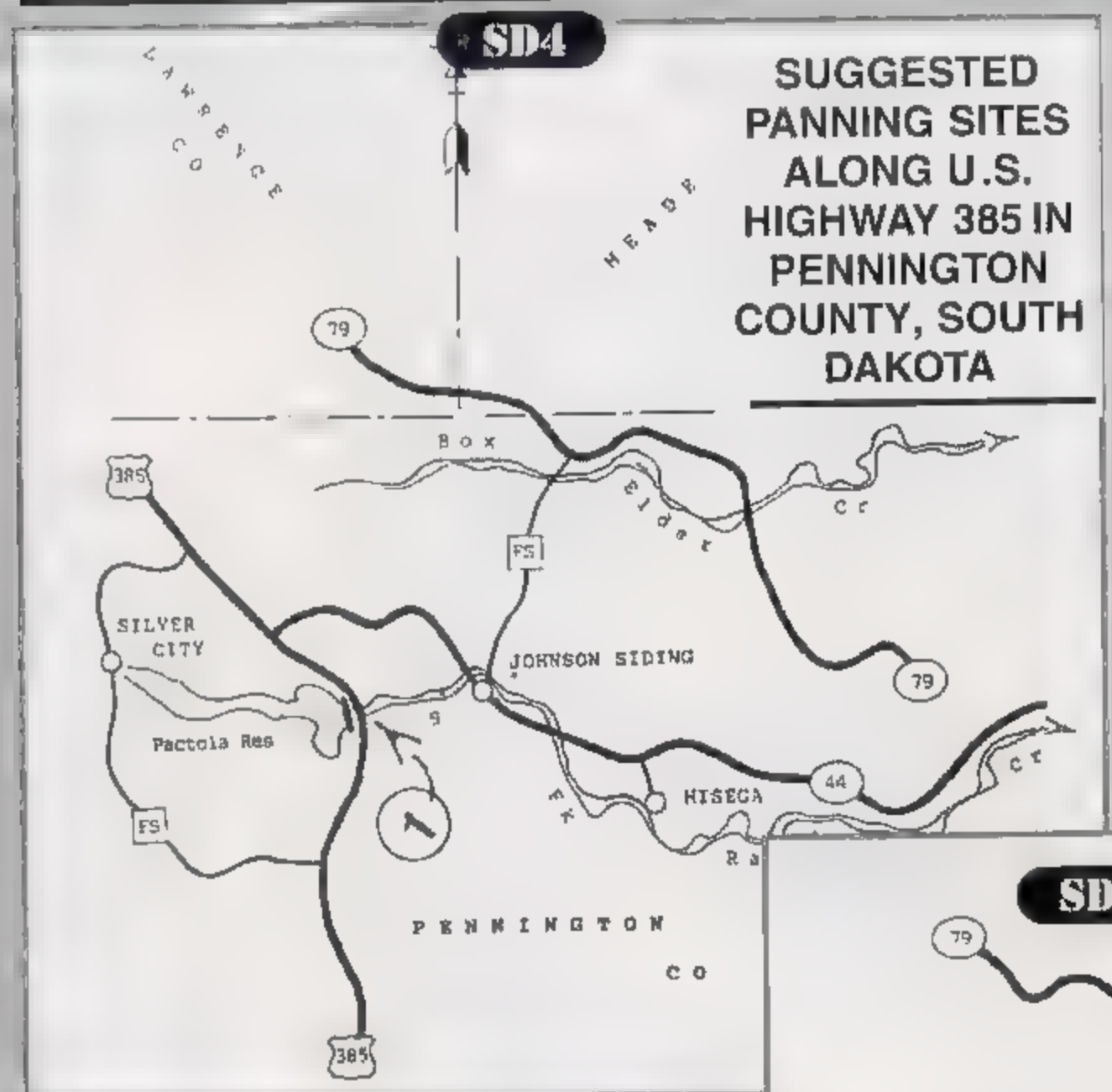
SUGGESTED PANNING SITES ALONG U.S. HIGHWAY 385 IN CUSTER COUNTY, SOUTH DAKOTA

SD3

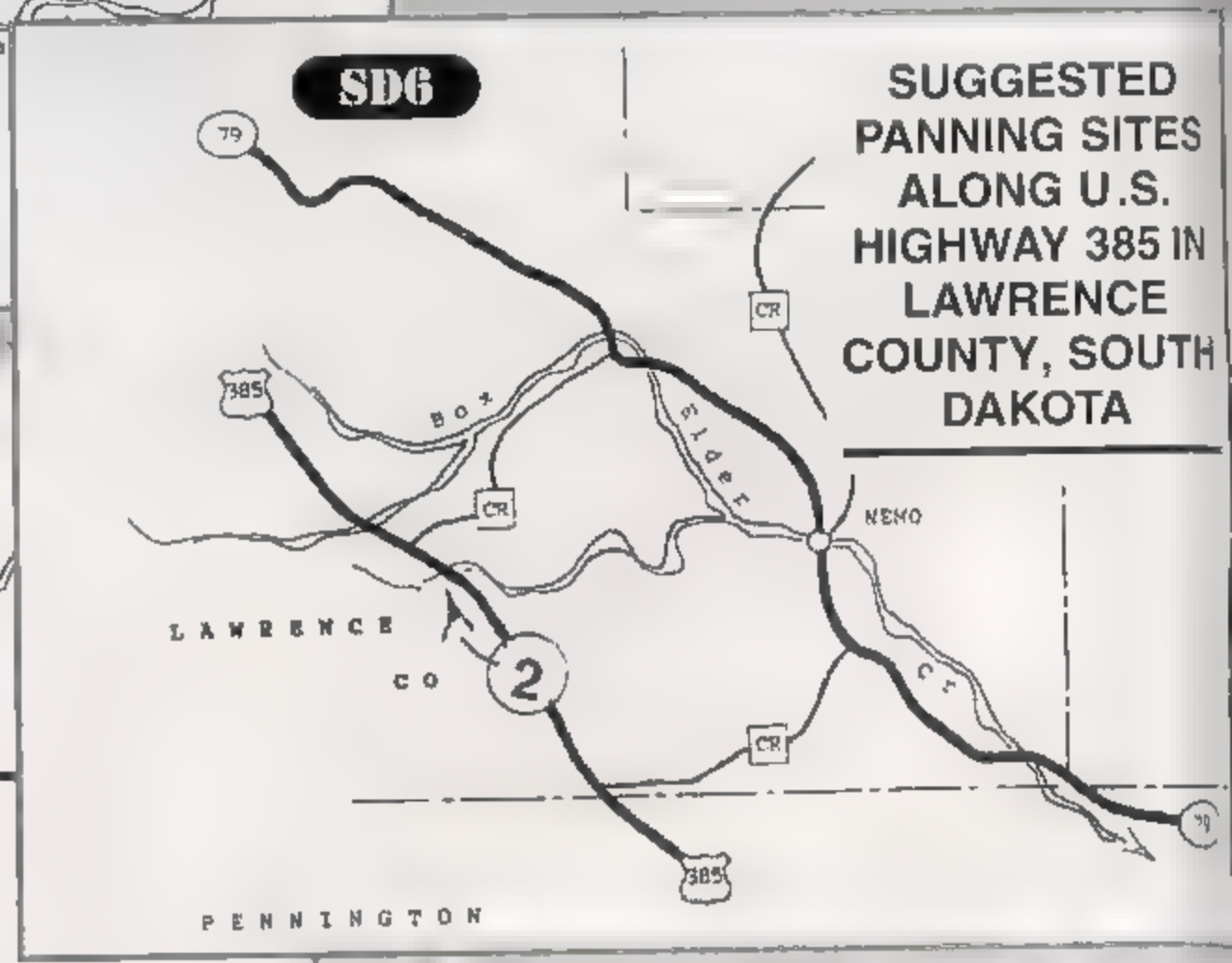


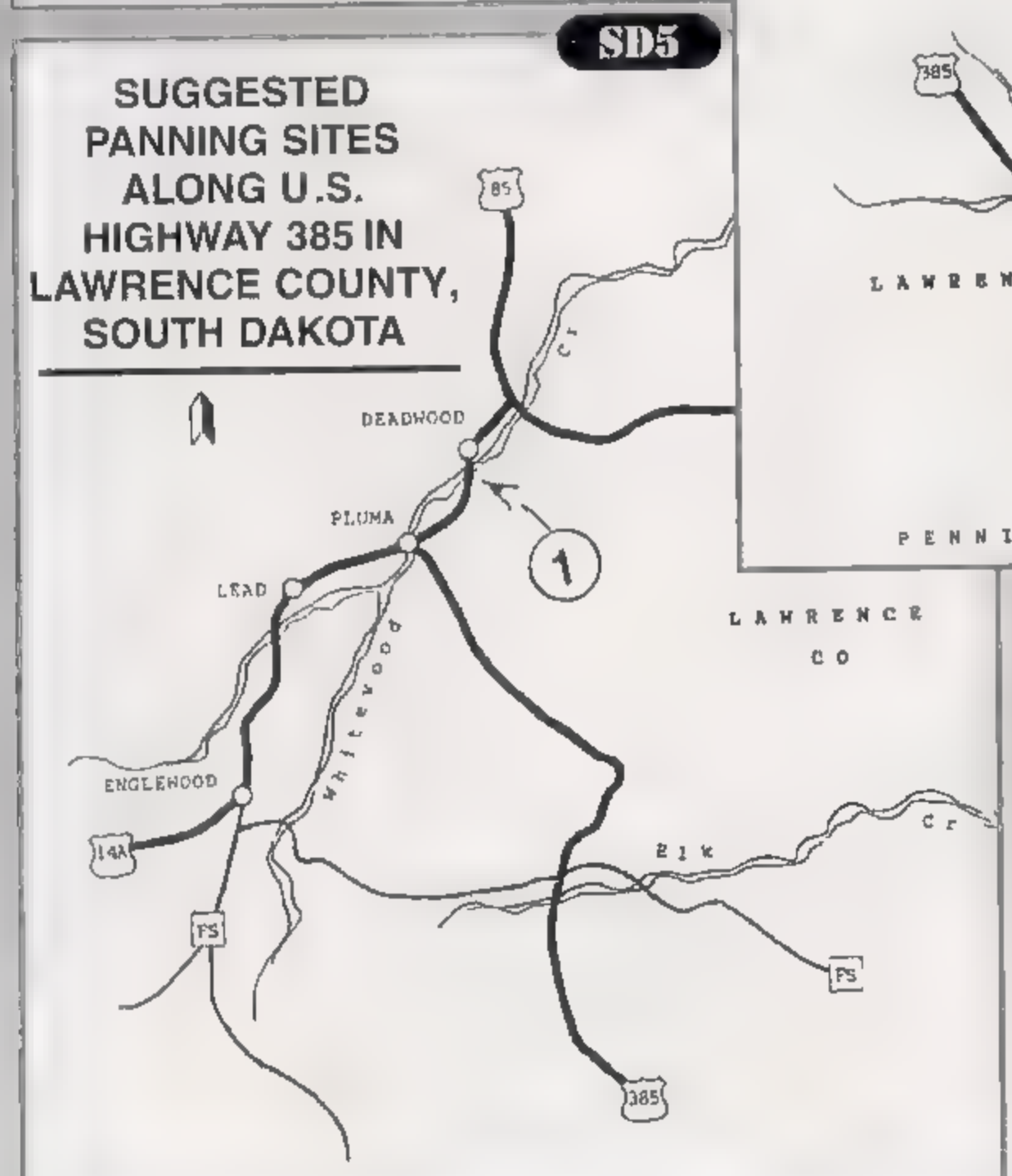
SUGGESTED PANNING SITES ALONG U.S. HIGHWAY 385 IN CUSTER COUNTY, SOUTH DAKOTA

PANNING SITES ALONG U.S. HIGHWAY 385 *from page 35*



Pennington County (Map SD4)
Site 1. Crossing on South Fork of Rapid Creek, near JOHNSON SIDING. Vicinity finds include amethyst, chalcedony, gold, and silicified wood.





Lawrence County (Maps SD5-6)
Site 1. Crossing on Whitewood Creek, near DEADWOOD. Vicinity finds include amethyst, chalcedony, gold, and silicified wood.
Site 2. Crossing on tributary of Box Elder Creek, near NEMO. Vicinity finds indicate gold potential.

PROJECT

MAKE A STERLING SILVER BOOKMARK

An Afternoon's Work Makes a Nice Gift

by Diane Prokop

A sterling bookmark is a wonderful gift, even if the recipient reads only the *TV Guide!* It also is an interesting way to showcase a favorite bead. I have made several with my handmade glass beads, and place them on bookshelves for display. They are easy to make and can be fabricated in an afternoon. This bookmark uses a gold end bead, but a sterling bead may be substituted. In fact, the entire bookmark can be made from copper or brass and finished with a patinating agent with very pleasing results.

Solder the gold ball to one end of the silver wire using medium solder. (Bob Prokop photos)

SOLDER THE GOLD BALL

Begin by cutting a 7-inch piece of 12 gauge round sterling silver wire. Place a large file on a flat surface and run both ends of the silver wire over it until they are flat and clean of burs.

Place one end of the wire in a third hand with the other end resting on a solder block. Rest the gold ball against the end of the wire on the solder block and place two tiny slivers of medium solder against the seam where the two come together. Flux the area and use a large, bushy flame to warm the entire length of the wire and the gold ball. The ball will not adhere to the wire unless the entire length of silver is brought up to soldering temperature. When the solder begins to melt, focus the heat around the seam and use a solder pick to push the two pieces against each other. Remember that solder will not fill a gap.

Plunge the soldered wire into the pickle pot until the oxidation is removed. The wire should look shiny, with a new layer of silver brought to the surface.

This is a good time to polish the bookmark. If you are using a stand-alone polishing unit, begin by loading the polishing wheel with rouge. Turn the unit on and place a stick of rouge against the bottom third of the spinning wheel until the wheel turns red. Do not overload the wheel.

Use both hands to hold the bookmark against the bottom third of the wheel until a high polish is obtained. Polishing metal with a spinning wheel is a potentially dangerous job. Always wear goggles and hold the piece with two hands, making sure to keep it in the lower third of the wheel. Wash the wire in hot, soapy water and dry it.

Place the wire on an anvil and use a hammer to stamp the sterling quality symbol into its side.

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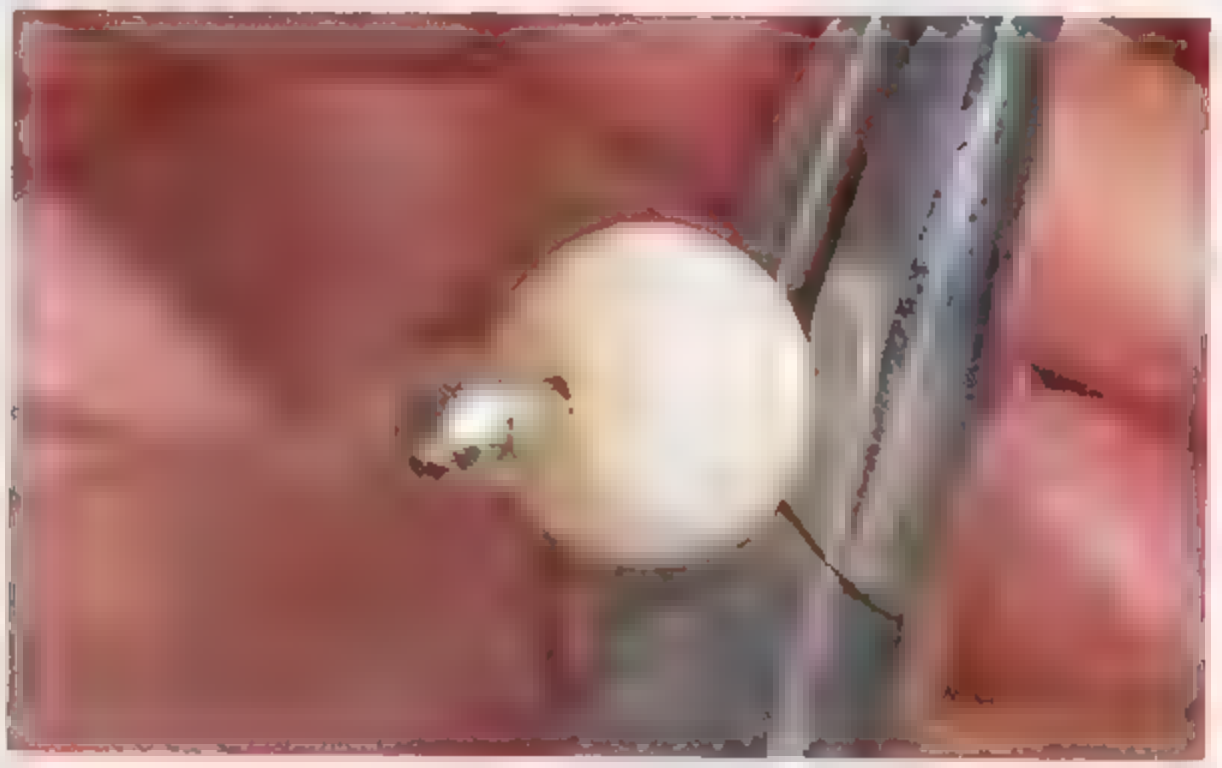
Polish the wire in the bottom third of the wheel, holding it with both hands.

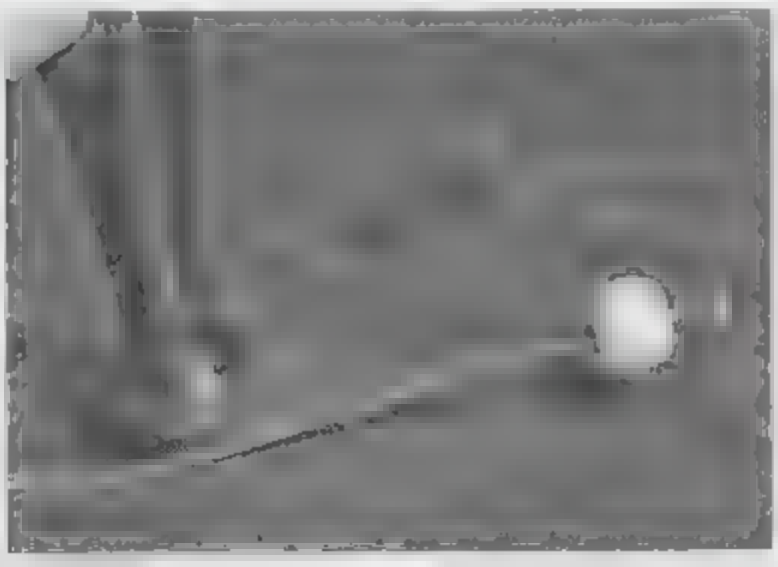


Grasp the wire with flat-nose pliers just beneath the head and squeeze until it begins to flatten.

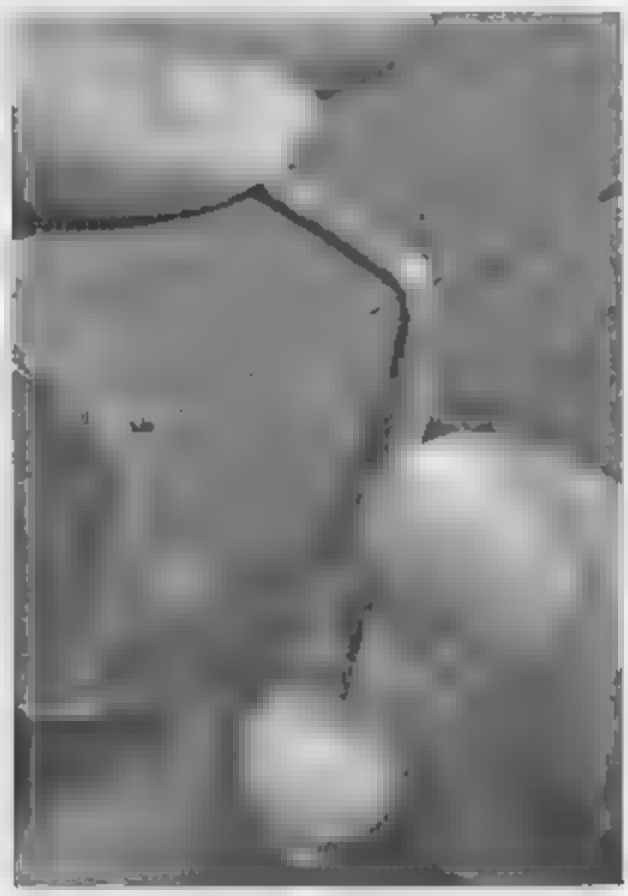
Use a regular flat-nose hammer to flatten the wire next to the head.

PROJECT

Make a Sterling Silver Bookmark *from page 41*



Use a planishing hammer to flatten, decorate and burnish the rest of the wire.



Mark the wire 2 inches down from the gold bead and bend it 45 degrees on the edge of the anvil.

PLANISH THE WIRE

Thread your special bead onto the wire until it lies against the gold end bead. Grasp the wire just beyond the bead with flat-nose pliers and squeeze until the wire begins to flatten. Place the wire on an anvil, letting the beads dangle off the side. Use a flat round-nose hammer to flatten the area next to the special bead, being careful not to ding it. You may wrap the bead in tape to protect it. Hammering will widen the diameter of the wire and prevent the bead from moving around. Switch to a planishing hammer and flatten the rest of the wire. The planishing hammer will decorate the wire as well as burnish it with a high sheen.

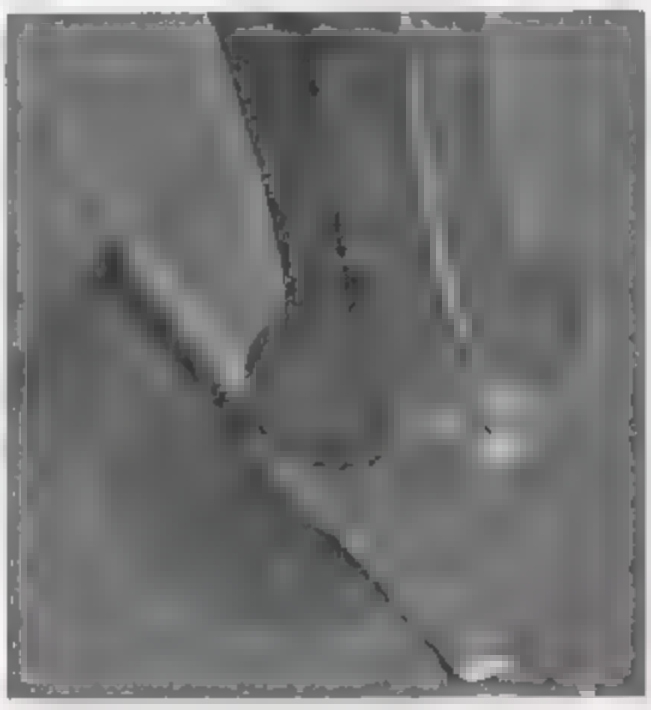
SHAPE THE BOOKMARK

The wire will have lost its original shape by this point. Place the bookmark on a block of wood and use a leather mallet to straighten it. This will also help temper it.

Mark the bookmark at a point 2 inches down from the top of the gold bead. Lay it on an anvil with the marked point at the edge of the anvil. Use your fingers to bend the wire down about 45 degrees. Use a pair of flat-nose pliers to sharpen the crease in the bend.

Use the pliers to bend the point behind the bead 90 degrees so that the bead forms a right angle to the bookmark. Re-polish the bookmark and you are done.

Use flat-nose pliers to bend the wire just below the head up 90 degrees.



Planish the bottom of the wire until it spreads out into a rounded arc.

ROCK & GEM

The Three Apatites

Guest Editorial:
Collecting Magnetite

by Sarah Dodson, Age 11

One Sunday, my family and I took our Jeep out near Bartlett Lake, Arizona. We passed many dry riverbeds, and we stopped at two of them because we saw patches of black sand. We were hoping the black sand would be magnetite.

My sister and I took magnets from our geology kits to see if the black sand would stick to them. We knew the black sand was magnetite when it was easily collected with our magnets. We were very excited.

Magnetite is an important iron ore made of iron and oxygen. It is black and its luster is metallic to dull. Magnetite's hardness is Mohs 5.5 to 6.5. Magnetite forms octahedral crystals that are opaque, which means you can't see through them. Magnetite can be granular, like the black sand we found, or it can form oddly shaped rocks.

Magnetite is found in South Africa, Germany, Russia, and the United States. A naturally magnetic piece of magnetite is called a loadstone. When you hang a lodestone from a string, one end will always point north. Christopher Columbus used a lodestone as his compass.

We collected a tad bit of magnetite and learned some things on our own. It is difficult to clean all of the granules off the magnet, because they keep sticking and move to the other side of the magnet. Also, some grains of sand get caught up with the magnetite and have to be cleaned out later on. The most exciting thing we discovered was how soft magnetite feels while wiping it off the magnets with your fingers. We had no idea it would feel so soft.

You can find magnetite too. Just look for black sand in a dry riverbed. We had a lot of fun.

Editor's Note: It is easier to remove the magnetite if you put your magnet into a plastic baggie before collecting. Just turn the bag inside out, and the black sand is neatly captured.

KIDS

by Steve Brock

Book Review

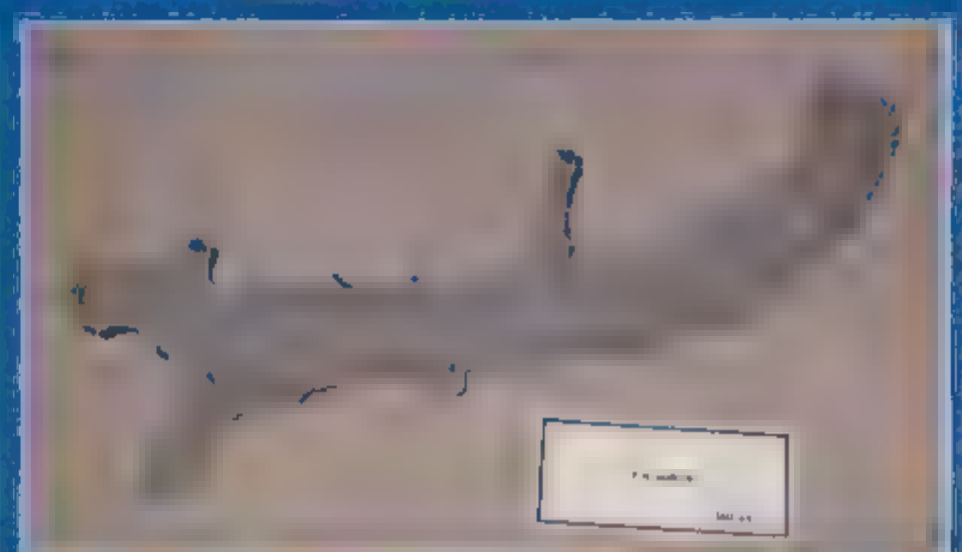
Rock & Gem Kids Quiz

The *Rock & Gem* Kids Quiz contest is open to U.S. residents age 18 and younger. All these questions can be answered by carefully reading this column. Write your answers neatly on a postcard or 4X5 card and e-mail to **Rock & Gem Kids Quiz, P.O. Box 6925, Ventura, CA 93006-9899.** Valid entries received by **Sep. 30, 2004** will be entered in a drawing from which five winners will be chosen. Valid entries must be the entrant's own work and must include the correct answers, the entrant's name, age and address and the signature of a parent or guardian. Prizes are generously provided by the Arizona Mineral and Mining Museum Foundation.

1. What is a natural magnet (like Columbus used as a compass) called?
2. Magnetite is an iron ore made of what two things?
3. Black sand in a dry riverbed may be what form of magnetite?
4. What element can be obtained from apatite and used as fertilizer?
5. Apatite may combine with copper to produce _____

Fulgurites

by the Arizona Mining and Mineral Museum



A Teary Salute

9/11 Victims Receive a Tribute in Quartz

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

by Bob Jones

It has been three years since two airplanes crashed into the World Trade Center towers. Like the assassination of John F. Kennedy, most of us can remember exactly where we were and what we were doing when the news broke about this horrible disaster. Plans have now been developed to create on that sacred ground a national memorial to those lost that day.

While the permanent memorial salutes all who were lost on Sept. 11, 2001, smaller memorials have been created for groups of people within the body of several thousand victims. Examples are the memorials to firemen and police who lost their lives.

Among the thousands who were killed, 11 souls who worked on the 94th floor of the North Tower were employed by the vast American Express Co. To ensure that these 11 employees were properly memorialized, the company asked Ken Smith, noted New York landscape artist, and Lawrence Stoller, one of this country's top large-stone carvers, to create a memorial that would honor them. The memorial was to go in the main lobby of the American Express Tower, located close by the fateful site. In fact, when you stand at the now completed memorial, you can see Ground Zero.

When the idea of a memorial emerged, the company asked six artists to contribute their visions of the tribute. It was only fitting that American Express employees who actually worked with the fallen 11 form a committee to study and choose from the submitted design ideas. The decision was a stroke of genius. These employees were joined by others whose input helped the group reach a decision. There is no doubt in my mind that their choice is not only a noble one, but a most elegant and touching tribute.

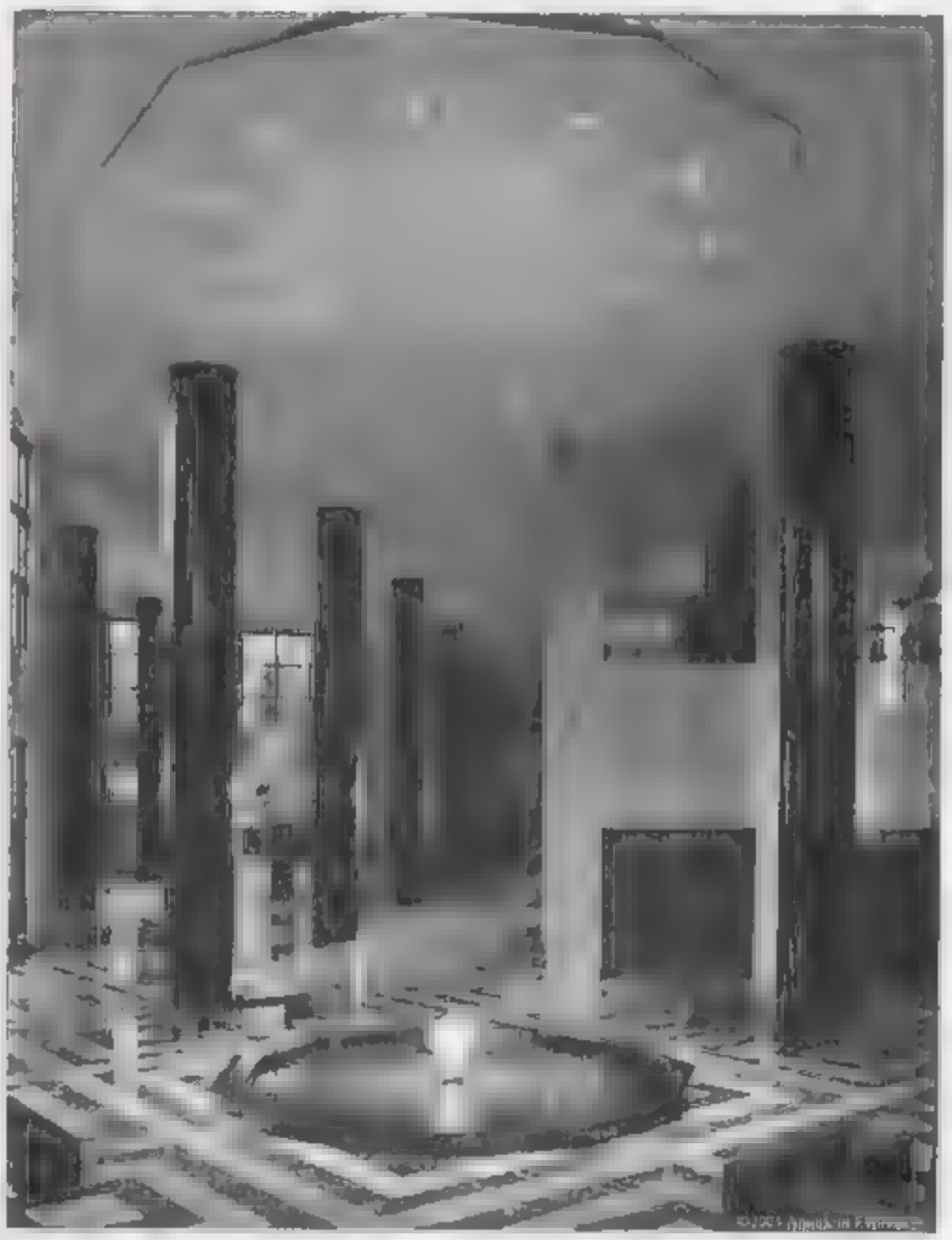
The design Smith proposed took a natural approach: water, granite, quartz, metal, and to give the memorial an ethereal effect, tasteful and strategically placed lights. He envisioned a large quartz crystal suspended over a pool of water. The quartz had to be shaped rather like a tear, and would drop "tears of remembrance" into a reflecting pool. The quartz had to be of sufficient size to impress anyone who viewed the completed memorial.

Once Smith's design was selected, he had to find an artist not only experienced enough to locate such a crystal, but with the skills necessary to work it. The crystal would be sculpted into an appealing, yet functional, shape that would guide and deliver the "tears" as it reflected light. Smith chose one of this country's exceptional gem carvers, Stoller, to hunt for and select the crystal, and to create the desired shape. If you have been to the Gemological Institute of America or several other museums and gem shows, you have seen and marveled at Stoller's work. One example you may be familiar with is the superbly carved myrickite featured in the November 1999 *Rock & Gem*.

It took some time for Stoller to locate a suitable quartz crystal. Natural, huge, quality quartz crystals are rare items. And when you start carving into a crystal — any crystal, from ring stones to the largest faceted work — you lose most of the mass. You might think the ideal crystal would be completely fracture free and flawless. That's not what Stoller wanted. He wanted imperfections that he could use to advantage in the final crystal shape, for imperfections are what bring an otherwise colorless and, some say, lifeless quartz crystal to life.

The obvious place to hunt for such a large quartz crystal was Brazil, long the most important source of superb and large quartz crystals from the myriad famous pegmatite deposits mined there. Stoller, because of his long history of working with large crystals, had contacts in Brazil, and he let them know what he was looking for. From a pegmatite mine near

Water drips down the supporting cables and over the crystal face to fall tearlike into the reflecting pool below.



Governadores Valadares, long a source of outstanding tourmaline, quartz, and associated minerals, a superb crystal weighing 1,100 pounds came to light. Harvey Siegel of Aurora Mineral Co. in Freeport (Long Island), New York, was instrumental in bringing the natural crystal to Stoller who immediately began studying the large quartz before ever condemning it to the diamond saw.

Usually when cutting huge crystals or rocks, as in marble and granite quarrying, a steel cable with cutting grit is drawn across the surface again and again. This eventually slabs the rock. But Stoller felt time was of the essence, so he started with a hand-held concrete saw. According to Stoller's notes, it took 14 days just to reduce the quartz to a manageable size so the actual work of faceting could begin. At times, Stoller even used a hammer and chisel on the quartz. All this cutting produced a 600 pound, tear-shaped stone that is about 30 inches from top to bottom.

Keep in mind that a natural quartz crystal is six-sided. Stoller wanted to facet the crystal with 11 geometrically calculated faces. Stoller first tried his design on a small piece of quartz until he was sure he had the right technique. Time and time again, Stoller positioned the huge quartz crystal, each time cutting one of the faces. Finally he had what he wanted: a tear shaped quartz with 11 faces tapering downward from the central girdle.

Of course, when you cut a quartz crystal, the next step is to prepare it for polishing. Using pneumatic air tools and an array of polishing pads over a period of two months the crystal was prepolished. Before doing the final polish, Stoller and architect Smith decided to actually suspend the crystal, to be sure the entire suspension mechanism function properly and the quartz hung straight.

continued on next page

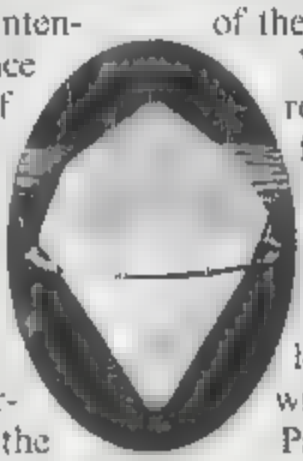
A Teary Salute *from page 57*

★ ★

As it so happened, the crystal did not hang right. It was heavier on one side than the other, so it hung not only at an angle, but off center! This required more cutting until the crystal was perfectly balanced. The resulting polished quartz was to be suspended by 11 cables attached to the overhead canopy and fastened to a stainless steel belt that would girdle and cradle the quartz. Imagine the patience needed to get that massive crystal suspended so it was perfectly balanced and centered over the reflecting pool.

Once the suspension problems were solved, the quartz was removed and readied for final polish. This was achieved by a team of 11 persons, each assigned to one of the faces and one of the top facets, which also numbered 11. Stoller, with an eye toward the historical import of this work, had invited 11 people skilled in hand polishing to do the honor of bringing this project to fruition.

All natural quartz has inclusions and fractures. In this case, they were intentionally used by Stoller to enhance the piece. To take advantage of what are normally distractions or flaws in a crystal, lighting designer Jim Conti installed lights in an aluminum canopy above the suspended quartz and positioned them to create a rainbow of reflections and internal shimmering that lent a lively sparkle to the memorial crystal. Smith wanted the quartz to be the center feature of the fountain. By its size, reflective lighting, and superb design, it would draw viewers ever closer to the fountain, where they would discover the names of the lost 11.



As you have already grasped, 11 was the operative number for the entire memorial. The design of the fountain is based on that number. The base of the fountain is made of 11 blocks of black granite, which form an 11-sided shallow basin holding the reflective pool. Atop each block is etched the name of a victim: Yvonne L. Bonomo, Paul Zois, Anne Ransom, Lucia Crifasi, Bridget Esposito, Loretta Ann Vero, Karen Renda, Benito Valentin, Sigrid Wiswe, Lisa Kearny-Griffin, and Gennady Boyarsky.

The black granite floor of the pool is made of 11 wedge-shaped black granite plates, one assigned to each of the deceased. The team asked family members and friends to come up with five special words or brief phrases of remembrance dedicated to the memory of each person. To select these expressions of love and remembrance was a daunting task for sure. These expressions come from the heart and symbolize the way each family wishes viewers to remember the 11 lost souls, each a unique individual.

The quartz crystal was artfully designed, lighted and suspended with the termination pointing down toward the pool. It formed a perfect avenue for water to be dripped into the pool. The teardrop shape of the quartz serves a very definite purpose. Water is slowly dripped down the cables to the quartz. The water creeps inexorably over the crystal faces until it reaches the tip of the quartz, hesitates, then drops like tears into the pool. Drops fall at intervals of 10 to 15 seconds. As each drop falls, the ripples it sends out create a rhythmic undulation of the water's surface, making the water shimmer and dance with reflected light. The entire effect creates the artist's insightful theme "Tears of Remembrance."

It seems appropriate to repeat the words chosen by the victim's families as a remembrance and etched into the floor of the pool.

Yvonne L. Bonomo, Princess, reliable, caring sister, devoted fiancee, loving daughter.

Bridget Esposito, A special angel sent by God, loved by all, taken but not forgotten.

Benito Valentin, You gave us love, honor, joy, laughter, you'll be with us 'til the ever after.

Paul Zois, A father, husband, son who gave all unconditional love and loyalty.

Lisa Kearny-Griffin, Warm, happy, beautiful, always "fabulous!" wife and mother.

Lucia Crifasi, Family, joyful, nurturing, dedicated, compassionate.

Loretta Ann Vero, Sincere, thoughtful, trustworthy, loving and loyal, respected and loved.

Sigrid Wiswe, Loyal, beautiful, thoughtful, determined, loved family, adored cats.

Anne Ransom, Bravest, loving wife, loyal friend, caring daughter, devoted pet owner.

Gennady Boyarsky, Talker, friendly, good cheer, "no problem," devoted to family.

Karen Renda, Elegant, creative, artistic, thoughtful, beautiful.

We can only hope people will someday remember us in such a genuinely heartfelt, loving way! When in New York, make it a point to pay homage to these precious treasures lost to us all. Visit the lobby of the American Express building, pay your respects to these 11, then turn and do the same to the many other victims who were lost that fateful day in the World Trade Center. ◇

FIELD TRIP

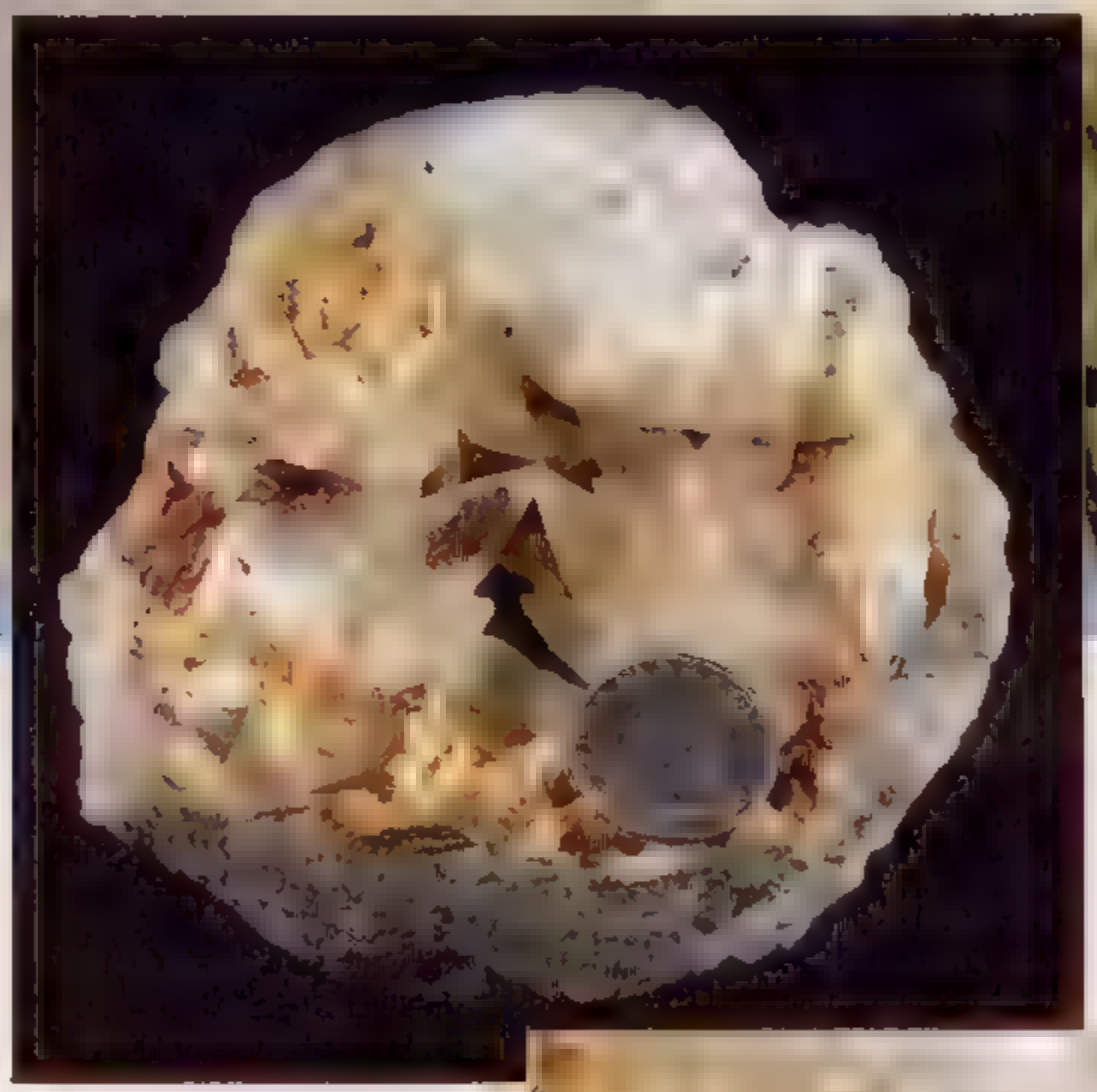
Monroe County Meanderings

Geode Collecting in Southern Indiana

by Mike Streeter

My wife, Chrissy, and I woke up before dawn on the day after Christmas to the sound of country music blaring on the clock radio. We had already packed our Dodge pickup the night before, so all we had to do was get dressed, round up our rock hound, Opal, and hit the road. Our plan was to head north from our home near Asheville, North Carolina, to southern Indiana, where we hoped to hunt geodes near Harrodsburg. The weather forecast for southern Indiana called for unseasonably warm temperatures for the weekend, so off we went. We could only hope that there wouldn't be too much snow left on the ground when we got there.

We became a little bit concerned about the snow potential while driving along Interstate 75 near Lexington, Kentucky, where much of the ground was covered with the cold, white stuff. But we continued on through Louisville and then north into Indiana. We were happy to discover that there was a complete lack of snow in southern Indiana. Ice, however, would be another story.



After a 7.5 hour drive, we arrived at the Harrodsburg exit of state Route 446 at around 2:30 p.m. We drove a few miles east past the dam and to the shore of Monroe Lake. I had learned from talking to other rockhounds and from past experience that this general area was an excellent geode-collecting location. Near the dam and adjacent to the lake is a large man-made cut in the limestone. Much of the material to build the dam was mined from this location, leaving a flat, grassy field that leads to the lake. The field is bounded on two sides by 80-foot, near-vertical walls of horizontally layered rock. The geodes in the uppermost layer are known to contain quartz, calcite and barite.

Calcium carbonate from dissolved limestone can recrystallize inside a geode forming dogtooth crystals. (Photos by the author.)

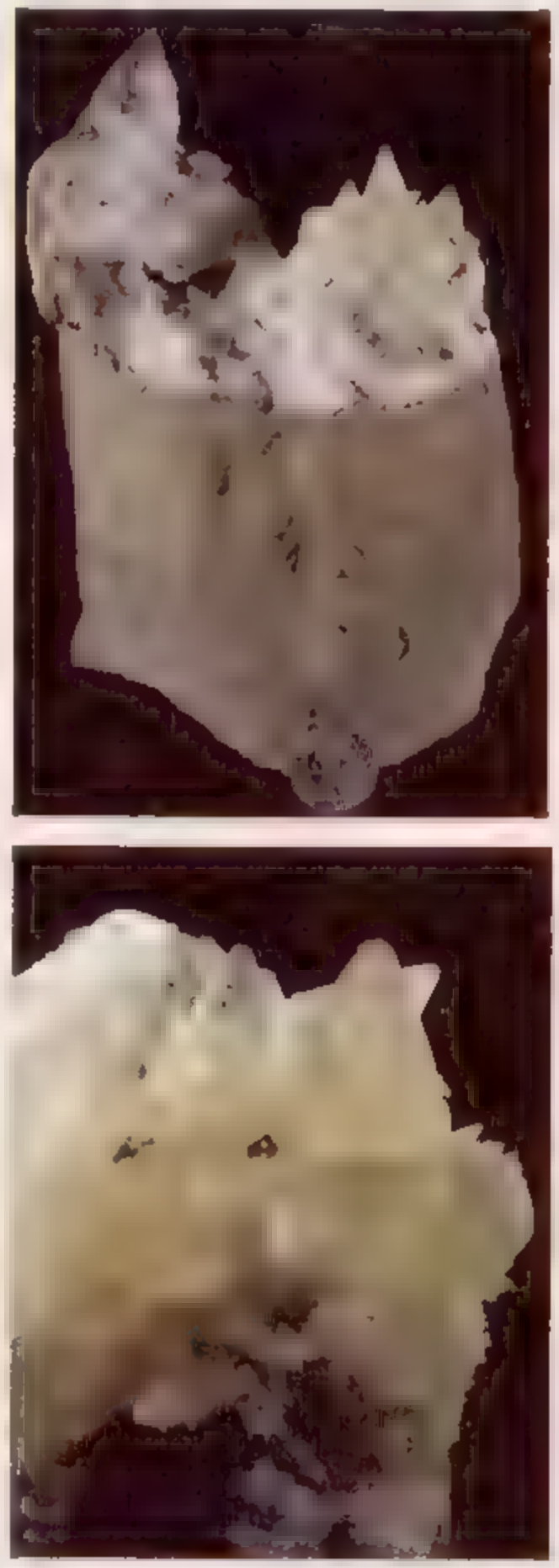
We parked in a gravel drive at the head of the grassy field. When we got out of the trucks, we could hear the familiar *chap, swap... chap* of another rockhound beating on rock. We looked up and saw a person near the top of the northern cliff nasily swinging a sledge-hammer. We knew that the car we had parked next to was his, as the backseat was covered with boxes of geodes of all sizes.

Knowing that it would get dark in a few hours, we quickly tossed our tools into our backpacks, grabbed a couple 5-gallon buckets, and headed off toward a trail that led up to the cliff top. At the top, we met Dave, a local rockhound who had been working a strip of rock along the uppermost shelf of the cliff. Dave had recovered many excellent geodes, having been there all day. He was particularly excited about the warm weather that allowed him to rock collect at a time when he would normally be stuck inside. Dave was very friendly and helpful and pointed out likely places to break rocks to find geodes. He also warned us about poison ivy. While digging in this spot earlier in the week, he had learned the hard way that contact with poison ivy roots causes a bad allergic rash the same way that contact with the leaves does.

Chrissy and I scratched around the top of the cliff with hammer and chisel for about an hour. I was able to recover a small, but nicely formed, geode that contained a drizzle of very pale amethyst crystals. We decided to go for a walk along the shoreline of Monroe Lake to see if we could scare up some easier finds before the day ended. Nothing spectacular ended up in our buckets, but the late-afternoon view of the lake was breathtaking. The light from the setting sun had turned wispy clouds mauve on the northwestern horizon, and the sky and distant tree lined shores were perfectly reflected on the mirrorlike surface of the lake. We accepted this magnificent sight as a good omen for the next day.

We woke up early on Saturday, excited to start our full day of geode hunting. We were excited by the weather forecast, which called for a high temperature of 51 degrees—a full 15 degrees above normal. We drove south on state Route 37 in the direction of Bedford to a high road cut just north of the Harrodsburg exit. This location is well known for having plentiful geodes in its limestone walls.

We drove up a muddy two-track road on the north side of the west cut and parked in a level, grassy field. Although the rocks are essentially identical on both sides of the highway, we chose to work the western side to take advantage of the sun that was rising in the eastern sky. Also, the ice that was hanging down both cuts in large sheets and icicles was far less pronounced on the western cut, since it receives considerably more daily sun exposure.



The very hard limestone matrix can make recovering whole geodes difficult, but partial geodes in matrix can be strikingly beautiful.

As a professional geologist and author of *A Rockhounding Guide to North Carolina's Blue Ridge Mountains* (www.mcrocks.com), I am keenly interested in the geology of any area where we rockhound. I discovered by studying the Indiana Geological Survey's Web site (http://igs.indiana.edu) that the rock formation containing most of the area geodes is the Harrodsburg limestone. Limestone is a broad term that refers to sedimentary rock in which calcium carbonate is the major constituent. Calcareous sediments, including the remains of marine animals, were deposited in a shallow sea that covered most of what is now the continental United States during the Mississippian Period, which extended from 360 million to 325 million years ago. The sediments would become buried, compressed by overlying materials, and cemented by calcium carbonate to form limestone. Various stratigraphic units within the formation contain different types of fossils and geodes. The fossils are the remains of extinct marine animals, including brachiopods, crinoids and bryozoans. But how did the geodes form?

It is thought that many varieties of Indiana geodes began as cauliflowerlike growths of gypsum that had either been trapped or formed in the soft calcareous sediments. The gypsum growths would gradually become encrusted with an outer shell of silica. The interior gypsum would later be dissolved by groundwater solutions, leaving a quartz-lined cavity in the limestone. At some later time, mineral-rich groundwater would make its way through rock fractures and the crystallization of minerals would take place from the outside in. The two most common minerals to crystallize in the geodes are quartz and calcite. The crystallization of these two minerals took place during separate phases, with calcite generally being the latter. Other more exotic minerals found in Indiana geodes include millerite, celestite, strontianite, barite, pyrite, and amethyst. It has also been postulated that geodes formed by the chemical replacement of calcite nodules and iron concretions by silica. Knowing how geodes formed may be interesting academically but finding them is the real fun.

According to the Indiana Geological Survey, geodes may be found in many locations in Monroe County. They are along the shores of Monroe Lake and in and along streams that empty into the lake, including Stephens Creek (six miles east of Bloomington) and Ramp Creek (east of Smithville). They are in other streams, including Clear Creek (three to five miles south of Bloomington) and Jackson Creek (two miles southeast to four miles south of Bloomington). They can be extracted from the bedrock of state Route 37 road cuts south of Bloomington. They are commonly found in ravines about the town of Bedford. Small geodes are reportedly abundant at the western end of the railroad tunnel west of Unionville. They may also be found along the banks of Bear Creek in northwestern Brown County. In northern Lawrence County, geodes can be found in and along the banks of Little Salt Creek, Guthrie Creek and Back Creek, south of Leesville in eastern Lawrence County, are also good places to hunt geodes.

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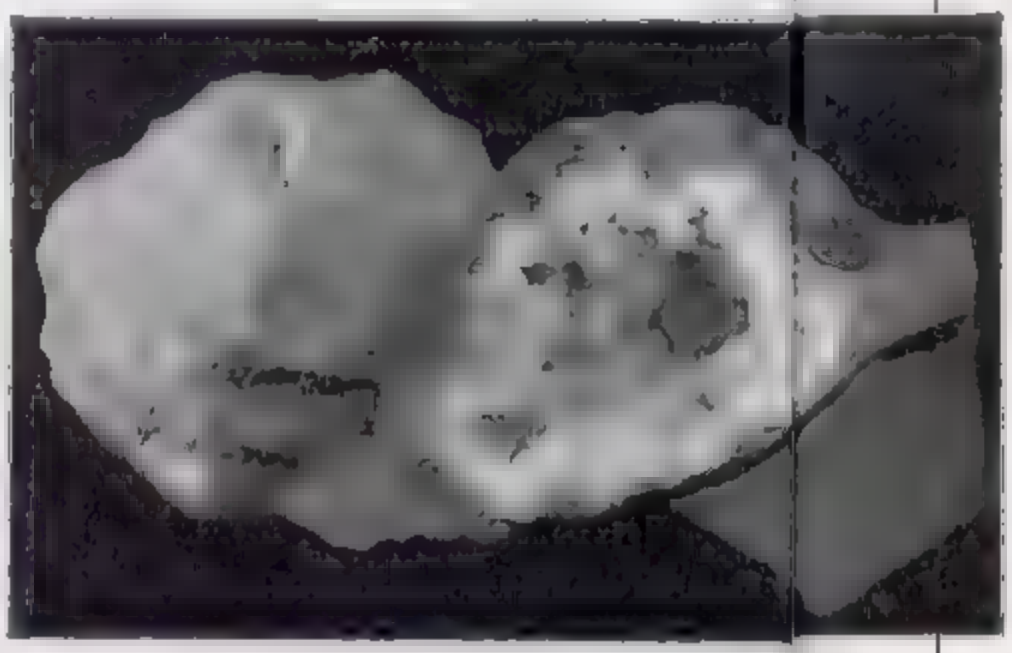
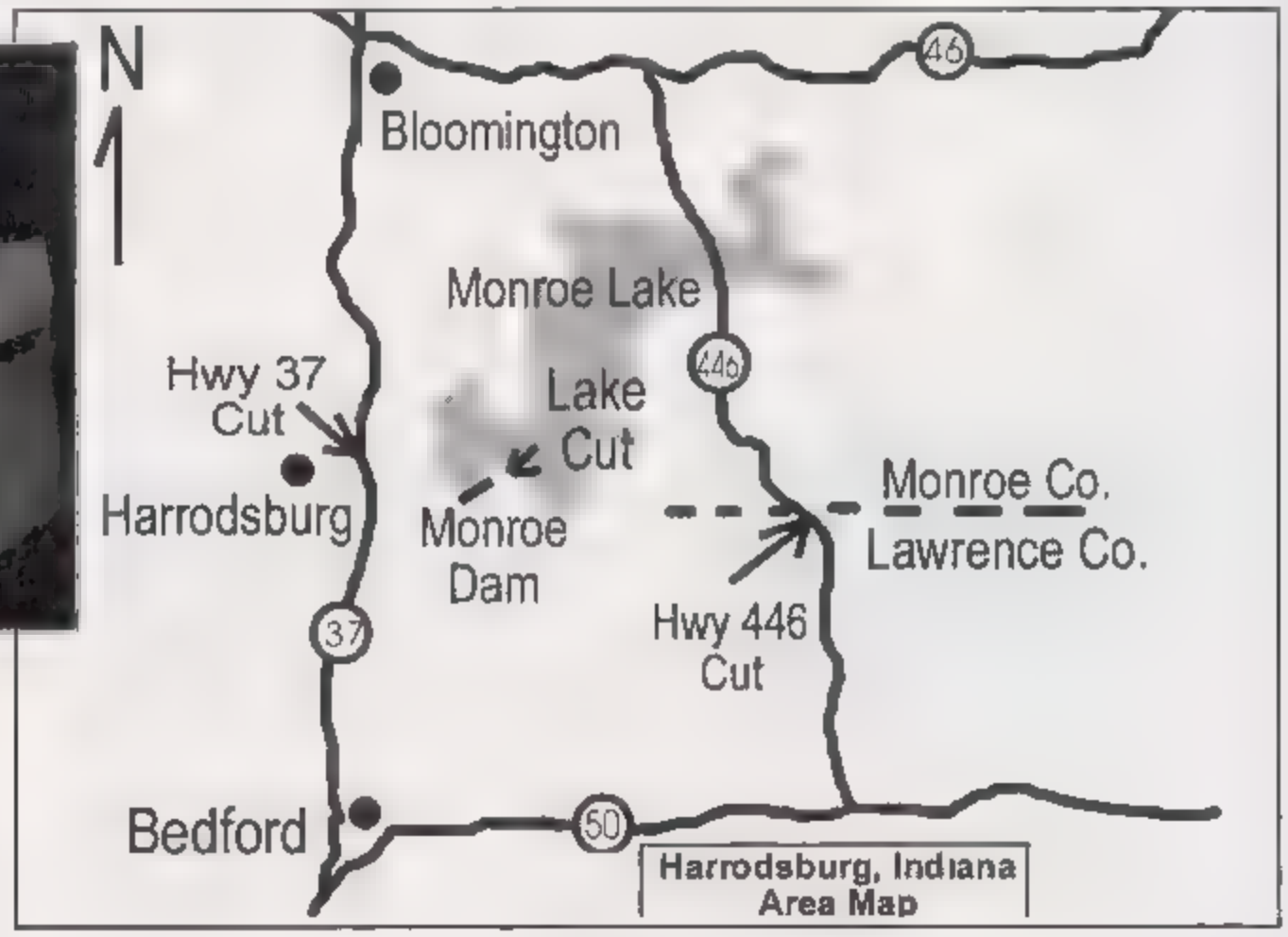


Geodes are often found one after another along a horizontal line in the limestone strata.

I had heard that millerite and calcite could be found in geodes collected from the first ledge above state Route 37 on the Harrodsburg cut, so we headed there. We made our way down from the top grassy level at the southern end of the cut to the beginning of a horizontal flat ledge that is about 7 feet wide and 20 feet above the road. As we continued northward on the ledge, we came upon a few small cedar trees in our path that had to be carefully scooted around. Beyond the trees, the ledge slopes markedly downward toward the road and is covered with a rock talus that includes countless broken geodes. Chrissy's pronounced fear of heights prevented her from getting past the cedar trees, so she retreated from the ledge and opted to collect in other areas where she didn't have to worry about taking a 20-foot header if she tripped. Opal doesn't share Chrissy's fear of heights, so my canine friend kept me company on the ledge. Her "four-wheel drive" serves her well on uneven and treacherous terrain.

Just past the cedar trees, I found a couple fair-sized geodes sticking partway out of the vertical limestone wall. Chisel marks surrounding a 6-inch-diameter geode indicated that another rockhound had attempted to recover it. Although I should have taken the hint that this geode would not be easily liberated, I began banging away around its sides with a pointed chisel and 6-pound sledgehammer. After about 40 minutes, during which it seemed that I was getting nowhere fast, I realized that maybe it would be a good idea to look around a little bit for easier pickings. I am not generally one to quit, but I didn't want to be there two hours later with only one geode to show for my trouble.



I discovered an area farther north on the ledge where geodes were also partially exposed and where the rock seemed to be less dense, with more fractures. I discovered that many of the geodes in this section of the wall had already been broken, but were still in place and some contained excellent calcite crystals. So I went to work again trying to expose and recover geodes.

I worked for about 5 hours with a 4-foot-long pry bar, pointed and flat chisels, and a 6-pound sledgehammer. It appeared to me that one section of limestone had been weakened as water flowing through internal fractures froze and swelled. The recent warm temperatures melted the ice, leaving behind expanded fractures and weaker rock. This enabled me to pry loose large vertical blocks and sheets of limestone from the wall, which exposed geodes. Unfortunately, the melting of the ice had another unpleasant effect that wasn't at all helpful to my cause. I had to spend much of my time on the ledge working beneath a melting sheet of ice that continuously dripped water and dropped ice fragments onto my head and shoulders. It was a good thing that one of the larger icicles didn't let loose and hit me or I would have likely ended up falling with it to the road below. This probably would have delighted any one of the many chuckleheads in passing cars who felt compelled to honk his horn or holler an unintelligible expletive at me while I was working.

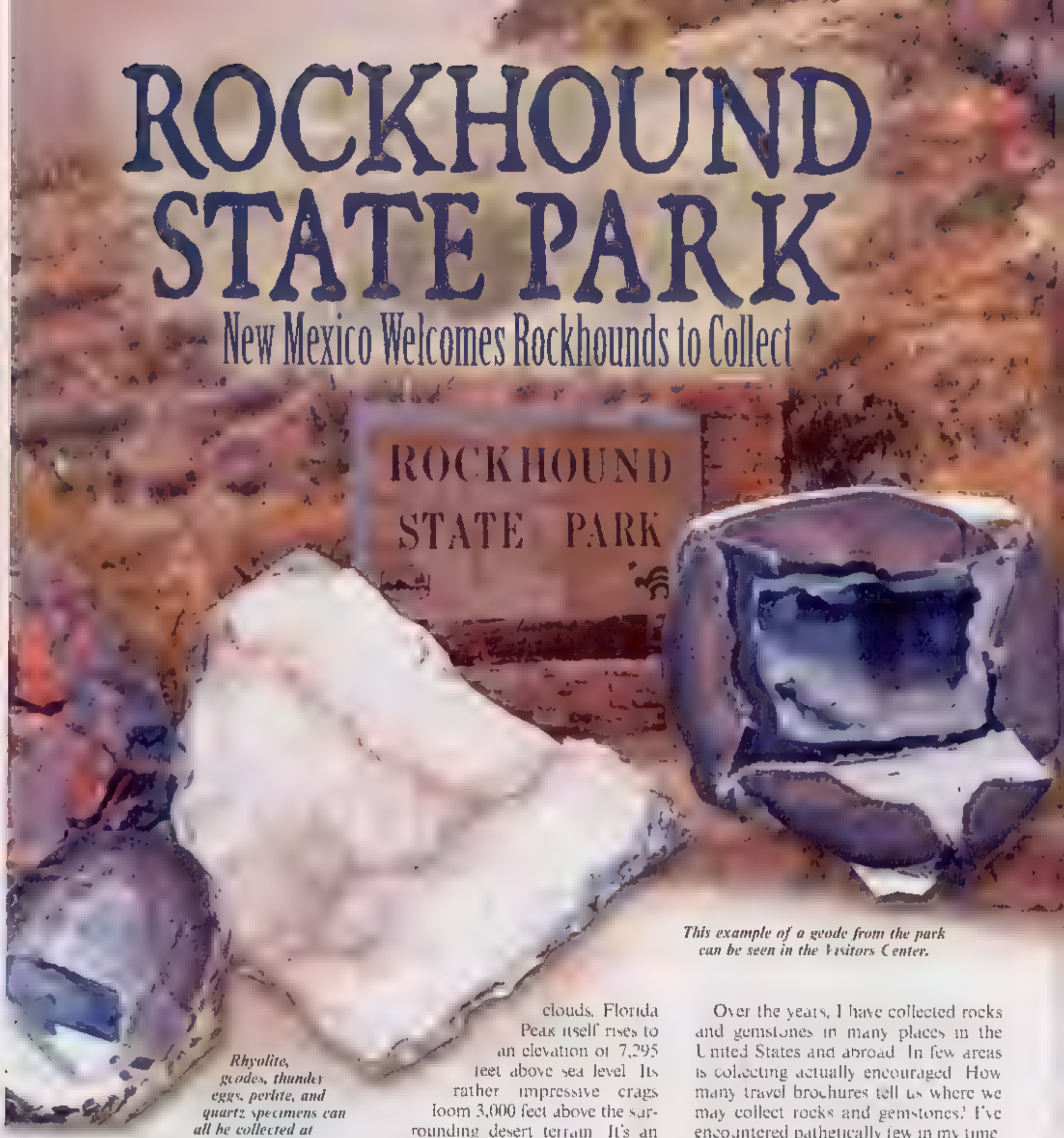
My efforts and perseverance were rewarded with some fantastic geodes that contain an assortment of minerals, including quartz, calcite, pyrite, and dolomite. I carefully ferried each delicate specimen to the south end of the ledge, where Chrissy felt comfortable enough to tread. She collected the specimens, one in each hand, and carried them in many trips up the hill to the truck. Chrissy gently wrapped and secured all the nice specimens. At about 2 p.m., we decided that we had gotten more than our share of goodies from this location and we were hungry. So, we packed up our stuff and drove about 15 miles south on state Route 37 to Bedford to look for our good friend Ronald McDonald.

From Bedford, we headed east on state Route 50 and north on state Route 446 to another road cut that is reportedly ripe with geodes containing pink calcite. We poked around this location for about an hour and a half and didn't find much of anything before giving up for the day. We saw lots of opportunities, but by then we were both too tired to expend much more energy.

We left this spot and drove in a westerly direction on twisting back roads with a plan to do more collecting at Monroe Lake, but we ran out of sunlight before we got there. Although we were never completely sure of exactly where we were on the confusing back roads, we maintained a westerly course and eventually found our way back to state Route 37. We spent another comfortable night in Bloomington and left very early on Sunday in an attempt to beat the holiday traffic back home. As is usual after one of our rockhounding adventures, the back of the truck rode a little closer to the ground but we weren't complaining.

ROCKHOUND STATE PARK

New Mexico Welcomes Rockhounds to Collect



This example of a geode from the park can be seen in the Visitors Center.

Rhyolite, geodes, thunder eggs, perlite, and quartz specimens can all be collected at Rockhound State Park in New Mexico. (Photos by the author)

by Kenneth H. Rohn

The sun was high in the sky one recent winter day as I entered New Mexico, "The Land of Enchantment." My day had begun at sunrise and I had been traveling east across the vast expanses of Arizona for several hours. Long before I approached the city of Deming on Interstate 10, the rugged peaks of the Florida Mountains came prominently into view. They dominate the landscape, their high spires seeming to touch the clouds. Florida Peak itself rises to an elevation of 7,295 feet above sea level. Its rather impressive crags loom 3,000 feet above the surrounding desert terrain. It's an inspiring sight.

At Deming in late afternoon, it was shirt-sleeve weather. It was becoming uncomfortably warm in my pickup, so I turned on the air conditioner. This was a far cry from the winter weather that I had left back home in Minnesota two weeks before.

My specific purpose for being here was to visit Rockhound State Park and spend some time collecting a variety of rocks. On many a cold winter evening, I had sat by the fireplace wondering what this unique park would be like. It's situated on the western slopes of the Floridas, 25 miles as the crow flies north of the Mexican border.

Over the years, I have collected rocks and gemstones in many places in the United States and abroad. In few areas is collecting actually encouraged. How many travel brochures tell us where we may collect rocks and gemstones? I've encountered pathetically few in my time. The Bureau of Land Management is one exception.

The 250 acres that encompass Rockhound State Park have been set aside specifically for rockhounds of all ages. It has a well-maintained campground with 30 sites. It's ideal as a base camp while collecting. The park has restrooms, showers, and a dump station, plus handicapped ramps and parking areas.

To reach Rockhound State Park, once you're in Deming, take state Route 549 east for approximately six miles to state Route 143. Take this road south slightly less than six miles to the park. You'll see prominent signs pointing the way. Here,

I didn't collect the maximum 20 pounds of material during my visit, but I came away with a nice selection.

you can dig to your heart's content and use your screen, if you're so inclined, to find a great variety of interesting rocks and semiprecious gemstones. All that's required is that you fill your holes and avoid damaging the plant life. For more information, write to Rockhound State Park, P.O. Box 1064, Deming, NM 88031, call (505) 546-6182, or visit www.emnrd.state.nm.us/nmparks.

Well-maintained trails lead to collecting sites in the park. Much of the park is actually situated on a mountainside. The trails leading up toward the summit were built on a gradual incline, but they can tax one's strength. Anyone negotiating them should be in reasonably good physical condition and somewhat acclimatized to this higher elevation.

I'm a low lander. Where I live, the elevation is 1,300 feet above sea level. Walking in an area as high as this mountain, on these inclines, causes me to become out of breath in a hurry. I have to stop frequently. Still, there's no risk of altitude sickness, and anyone accustomed to this altitude, won't have any trouble at all.

At Rockhound State Park, you are allowed to collect up to 20 pounds of rocks and or gemstones during your stay. There are many variations and colors of agate and jasper, geodes that are sometimes lined with agate and opal, and solid nodules called thunder eggs. These "eggs" are also found filled with agate and opal, or a combination of both. Sometimes, other rare minerals may be discovered. Quartz crystals and specimens of perlite are also present.

Although not often found on the surface, understandably due to the large number of collectors who visit here each year, thunder eggs are occasionally discovered amongst the myriad outcrops and boulders on the mountainside. It may take some digging and slow, careful searching, rather than skimming over the surface, to detect these often inconspicuous gemstones.

continued on next page

Rockhound State Park *from page 71*

Thunder eggs are a most unusual phenomenon. They are found in areas where volcanic ash beds once dominated the landscape. Those ash beds have eroded away eons ago. Research and study of these nodules points to the fact that they were not formed in gas pockets and bubbles in lava as other types of chalcedony were. They came into being in porous volcanic ash deposits. Silica in solution settled and formed into rough nodule shapes in the voids in this loose volcanic ash.

Much later, it is assumed, these nodules fractured and split, letting in even more silica, layer upon layer, until the void was completely filled. The wonderful distinct bands that are usually found in these gems were formed this way. The different colors were caused by the elements and impurities that mixed with the silica solution at that particular time. Thunder eggs have an outer crust, or shell, of solidified ash, and look like ordinary, rough-surfaced rocks. Only when the egg is cut or cracked open is the beautiful core revealed. It's hard to tell whether you've found an egg or a geode until you break it open.

Geodes were formed in the same environment and time period as thunder eggs, but were not filled as completely. These hollow entities are often lined with quartz crystals, agate, and/or common opal. The interiors of these gemstones can vary from white (opal and milky quartz) to water clear (rock crystal), to many shades of blue, gray and brown (chalcedony). No two are ever exactly alike, except in chemical composition, and that, too, can often vary substantially because of those impurities.

A good example of the perlite found in the park can be seen at the Visitor Center. Fine mahogany perlite specimens are on display on the counter, although by no stretch of the imagination is perlite what one would consider a gemstone. It does have certain interesting qualities. It's actually a glassy volcanic rock that was formed by extremely high heat during an eruption. This material, upon reaching the cooler temperatures near the surface, quickly solidified. Not having had time to form crystals, it often appears as aggregates of rounded, pearly masses.

The milky variety of crystalline quartz, as well as occasional rock crystals, can also be found here. Jasper, found in several shades of brown to red, can be found without too much searching on the mountainside. I picked up a nice selection of mahogany-colored stones, many light-brown specimens, and even some pieces that are so dark they appear black.

Rhyolite, a product of volcanoes and an abundant igneous rock worldwide, is also present and can be found in plain or banded form in the park. It's so fine-grained that you need magnification to see the individual particles that it's made of. Banded rhyolite is the result of various mineral solutions in suspension infiltrating the rock. These watery solutions carried iron oxides and manganese, along with other elements, into the interior of this porous stone, producing the colorful contrasting bands seen in the better specimens. Banded rhyolite is also known as "wonderstone." Solid pieces of this stone can take a reasonable polish, but many specimens are too porous for anything more than a dull gloss.

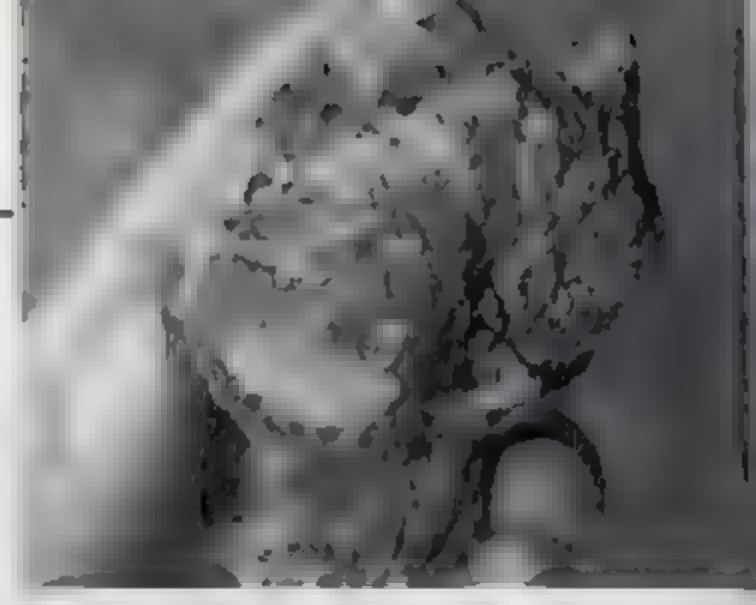
Upon reaching the park, I stopped at the Visitor Center and talked with the rangers. When I asked where I could collect rocks, I was told that the entire park, aside from the campground and other protected areas, is open to collecting. They told me that no petrified wood has been discovered here to date. However, I was shown a rock that for all intents and purposes resembles a tree fossil. It has all of the attributes and characteristics of petrified wood, but it isn't. It's a piece of brown banded rhyolite.

There's a wonderful display of gemstones and rocks that can be found in the park on the Visitor Center counter. The rangers mentioned that the better places to collect are a bit beyond the well-beaten trails. That is understandable. There are stones and minerals in the park that may defy identification. Your best bet is to ask a park ranger about them at the Visitor Center, where they can be correctly identified.

After talking with the folks at the Center, I picked a place to camp, walked a short way over to the pay station, and filled out the form. The camping fee is $10 per night. The day-use fee is $3 as of this writing.

I was anxious to investigate the mountain. It looks so inviting. There were still a few hours of daylight left, and I wanted to see what I might find before coming back to prepare my evening meal. So, I took a rock pouch, my hammer (just in case), a bottle of water, and my camera.

I took the main trail up from the campground. It's wide and rather smooth. It wasn't long before the climb had me puffing. I stopped to admire a gigantic rhyolite boulder resting beside the trail. It had to be 15 feet in diameter and though quite sturdy, looked as though a slight nudge could send it crashing down the mountainside. At some time in the distant past, possibly during an earthquake, this boulder tumbled down and came to rest at its present location. It will remain there, no doubt, until another catastrophic event takes place.



This thunder egg was not the prettiest, but it contains a beautiful blue agate core.

When I had walked several hundred feet along the trail, I looked back at the campground. I could see for miles in any direction. A dust storm was in progress on the horizon, obscuring the distant landscape. My camper looked like a child's toy far below. Prickly pear cacti grow in profusion on the lower elevations on this mountainside. Surprisingly, stunted junipers and several other varieties of shrubs and plants thrive up to the tree line in this dry, rocky environment.

I discovered a miniature canyon almost hidden by trees below the trail. When I stepped down to investigate, I saw evidence here and there of rocks having been broken by collectors. I studied the ground carefully, moving very slowly in an area alongside the wall where erosion had taken place. It was here that I saw something unusual. I picked up, of all things, a tiny thunder egg. It's no larger than my thumb, but it's almost perfectly round. One side has been fractured away, revealing a beautiful blue agate core.

It wasn't long before I found other interesting rocks. One nice specimen of red jasper went into my rock bag for later inspection. I climbed higher, bypassing large boulders and dense shrubbery along the way. I met a few other rockhounds here and there, but the park certainly wasn't what one would call overcrowded.

With my curiosity satisfied, I walked back down to the camper and my evening meal. I had had a busy day and it was soon time to turn in. I would be out bright and early next morning.

A cold front moved in during the night and with it a brisk wind. That was the cause of the dust on the horizon the afternoon before. I awoke once to feel the camper shaking a bit from the gusts. Along with the wind, came cooler temperatures.

After breakfast, I put on a light jacket and started up the trail. The shirt-sleeve weather of the day before had gone with the cold front. A cool wind was at my back as I returned to the places I had previously inspected. I stepped off the trail and began searching in a new area.

On every field trip, I always carry two gold pans, a large one and a smaller one, several different screens, including a gem

Another tiny thunder egg has a "window" to the agate core inside

screen of fine mesh, a folding shovel, garden trowel, heavy hammer and a gad or two, plus an old flat head screwdriver and an ice pick. This morning, I left all the equipment in the camper except my hammer. I wanted to see if I could find some valuable rocks simply by searching the surface.

I stepped off the trail and went cross-country. The ground is rough and uneven, littered with loose rocks of all sizes, so it pays to step carefully. Also avoid contact with cactus if at all. They can be painful. I walked toward the southern slope, 200 feet or so away from the main trail, waiting for the sun to climb up over one crag that blocked it from view. I felt the instant warmth of its rays as I searched in a sheltered spot out of the wind.

I was scratching the surface with the pointed end of my hammer, when I exposed a thunder egg. It surprised me, because I could see where others had been digging nearby. They had missed this one. One end of this nodule was chipped away exposing the inner structure. It's not the prettiest of thunder eggs, and it's far from perfect in its uneven shape, but it is one, and it has a beautiful watery-blue agate core. Other colorful stones found their way into my rock bag that morning, including several nice examples of jasper, perlite, and banded rhyolite. Most are gray, with shades of orange and brown, and contrasting red-and-gray bands. Some specimens are almost black. I picked up one small, flat gray stone the size of a half dollar with a very thin layer of a blue-green mineral on one side. Could it be turquoise?

I had a great time at Rockhound State Park. I didn't leave with 20 pounds of rocks, but I gathered a nice selection and a good variety of what can be found there. The park is open year round, but if you arrive during the winter months, be prepared for often changeable weather. It never gets very cold here in winter, but summer days can be hot, because it's situated so close to the Mexican border. Be prepared for all situations and you won't go wrong.

The city of Deming has accommodations to suit almost any budget. If you aren't prepared for camping, you can do as I did and simply search the surface for interesting and sometimes valuable rocks.

It was midday when I left the park and traveled northeast toward home. Visiting Rockhound State Park had satisfied my curiosity, and indeed lived up to my expectations. It's a great place to spend a pleasant interlude away from the daily routine. It increased my knowledge of the Southwest a bit, as well. So if you happen to be in the area, it would be worth your while to stop in and spend some quality time in a park where collecting is actually encouraged.

Copper Minerals of

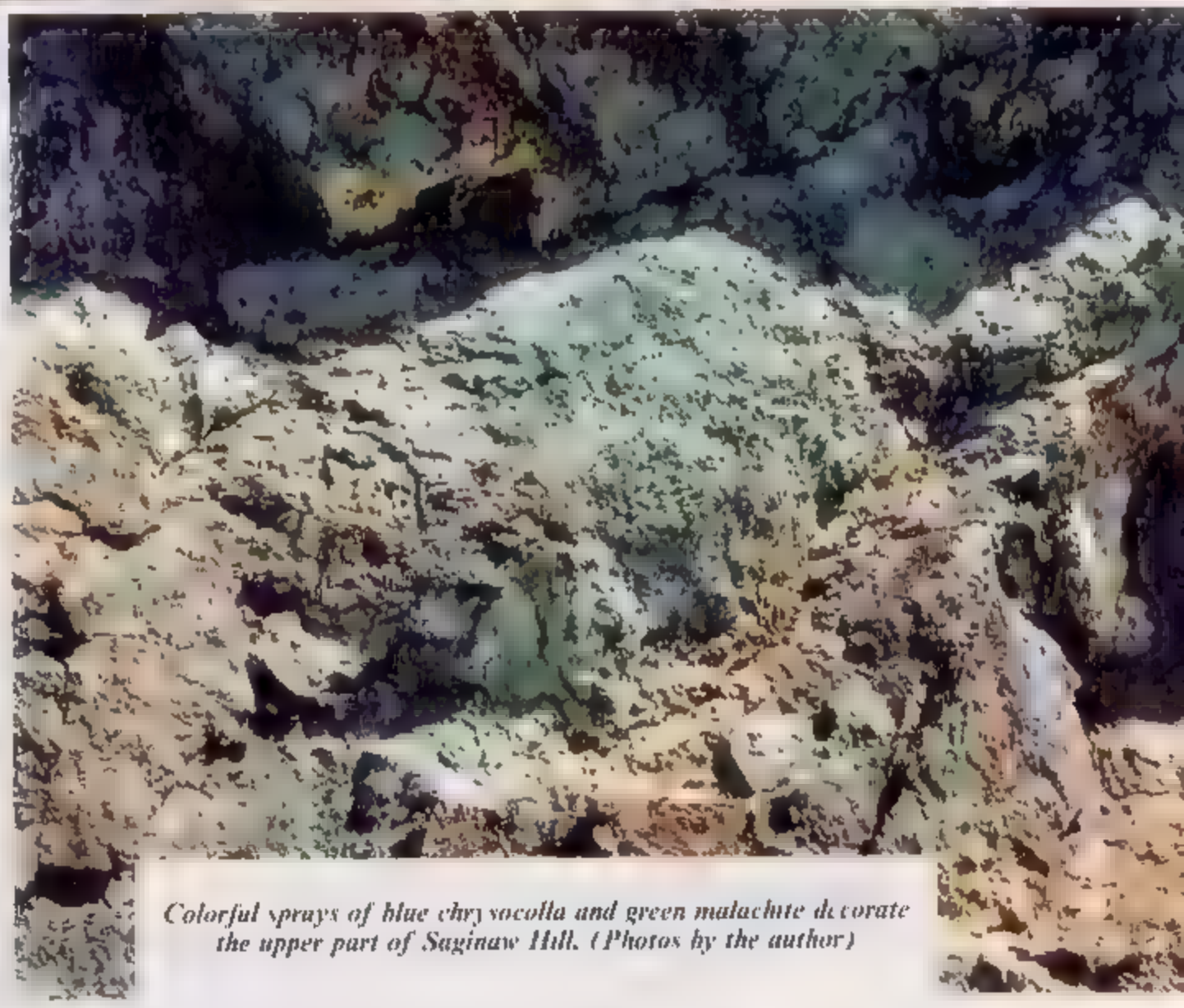
AN ABANDONED MINE SITE OFFERS EASY COLLECTING

by Roger Matthees

A rockhound's dream, Saginaw Hill is home to an old Arizona copper mine located southwest of Tucson. It is easily accessible and open to the public. Colorful sprays of blue to light-green chrysocolla and dark green malachite decorate the upper part of the large, rocky hill, and they are yours for the taking. In some cases, iridescent light blues to blue-greens can be seen. You can drive up to the mine in a high-clearance, four-wheel-drive vehicle. Although climbing is not necessary, care should be taken when walking up the hill, especially when small children are present. Loose rock from old mine workings and erosion peppers the site and can be treacherous. A sure-footed person can walk to the top of the hill, but again, watch for loose rock and short cliffs. The view from the top of the hill is spectacular, even breathtaking, and unhindered in all directions.

I learned about the locality from my good friends and neighbors Pat and Frank Tarkot, who recently checked out a library book titled *Minerals of Arizona: A Field Guide for Collectors* by Neil R. Bearce. A rockhound at heart, I was delighted to find how close the hill is to Tucson!

Located in the Sonoran Desert, Saginaw Hill is a small, inactive copper, zinc, lead, silver, gold mine where low-grade ore occurs in random splashes and seams. According to the online mineral database www.mindat.org, "Mineralization is sparse, spotty, partly oxidized base metal sulfides along fissure zones in limestone lenses in silicified Cretaceous arkose." The volume and grade of the ore body probably isn't sufficient to make it commercially profitable to extract and refine today. (Data on the mineralization of the Saginaw Hill Mine deposit and the recovery rate of minerals there can be obtained at www.mindat.org.) In some places, heavy staining of the host rock can be seen, but of course, this is surface rock. Who knows what lies beneath? The collector will have to search for these areas of color.



Colorful sprays of blue chrysocolla and green malachite decorate the upper part of Saginaw Hill. (Photos by the author)

The mine property comprises hundreds of open acres of desert brush, a large hill, and no visible buildings or artifacts. Crude dirt roads meander the site. An adit is visible three-quarters of the way up the south side of the hill, and coarse mining roads crisscross the hill. A dump containing discarded material from ore extraction can be seen on the west side, and a heap of black slag from what might have been a flux smelter can be seen to the northwest. The dump and possible flux site are fenced and posted with warnings of "high levels of lead and arsenic." The black slag looks somewhat tarlike. Part of what looks like a concrete foundation, possibly from a combination small mill and smelter, can also be seen here. The flux site is hard to locate at ground level. It sits just over a small knoll.

My own research on the site uncovered some interesting facts. From The Mineral Gallery (http://mineralgalleries.com), I learned that typical Arizona copper deposits originated with igneous intrusions, which brought silicates and copper sulfides, among other things, upward. Shrinking from cooling and other events fractured and brecciated the host rock. These fractures and cavities allowed hot hydrothermal fluids to enter the ore body, corroding and altering the rocks.

SAGINAW HILL

Good, loose material is readily available. The only collecting tool you may need is a bucket for your finds.

later, fluids brought the mineralization of more sulfide and oxide ores. Finally, the surface of the ore bodies weathered, leached into groundwater, and re-crystallized as copper oxides, carbonates, sulfates, and some silicates. Weathered, colorful surface deposits are referred to as gangue. More valuable secondary deposits may, however, lie beneath.

As described in Simon & Schuster's *Guide to Rocks and Minerals*, chrysocolla and malachite belong to the secondary group of oxidized copper minerals usually formed by the weathering of copper sulfides. Chrysocolla is a hydrous copper silicate, is blue to light green, and is relatively soft (Mohs 2-4). It is an indicator of disseminated copper deposits (porphyry copper ore). Malachite is a hydrous copper carbonate, appears emerald green, is semi-hard (Mohs 3.5 to 4), and is produced by the reaction of sulfides with carbonate gangue. When heated, chrysocolla turns black and does not fuse while malachite turns black and fuses. Perhaps these two minerals explain the appearance of the black slag.

The copper minerals of this site are fairly typical of the low grade ore found throughout Arizona. The more graphic displays of color (chrysocolla and malachite) can be found three-quarters of the way up the jagged slope to the upper right of an adit and in other spots, and appear to emanate from quartz seams in the host rock.

Take your time in exploring the upper reaches of the hill, as there seem to be many sources of color. The ore is gorgeous to look at, with endless hues of blues and greens blending into one another. The material, however, may not be well suited for cutting, polishing, and other lapidary work. Some of it is soft and crumbles. With diligence, you may find a few hard pieces, such as colorful minerals trapped in quartz. Specimens can be used as decorative rock or conversation pieces. This is a very large site with a lot of material. It will be a long time before it's depleted by collectors.

Collecting tools include a rock hammer or pick, and possibly a chisel or pry bar. Good, loose material is abundant three-quarters of the way up the hill. Little collecting material lies at the bottom. You may not need any tools at all, except a bucket for your finds. I simply picked up my specimens from the ground and readily acquired many nice samples, one of which showed blue chrysocolla frozen in hard quartz. The price of collecting is, of course, lugging the heavy material back to your vehicle.

It's hard to resist exploring the site for hours. Bring along a metal detector. Perhaps you'll locate some artifact of an exciting and adventurous era long past. Back then, mine safety had more to do with avoiding death than it did with preventing injury and illness. Miners took extraordinary chances with their lives in terms of handling and using explosives, freeing and moving loose rock, and exposing themselves to milling dust and the poisonous fumes and vapors of smelting. While there, let your mind wander. Imagine what it used to be and look like during the mine's working life. Imagine the sight and sound of miners busy cracking and blasting rock all day.

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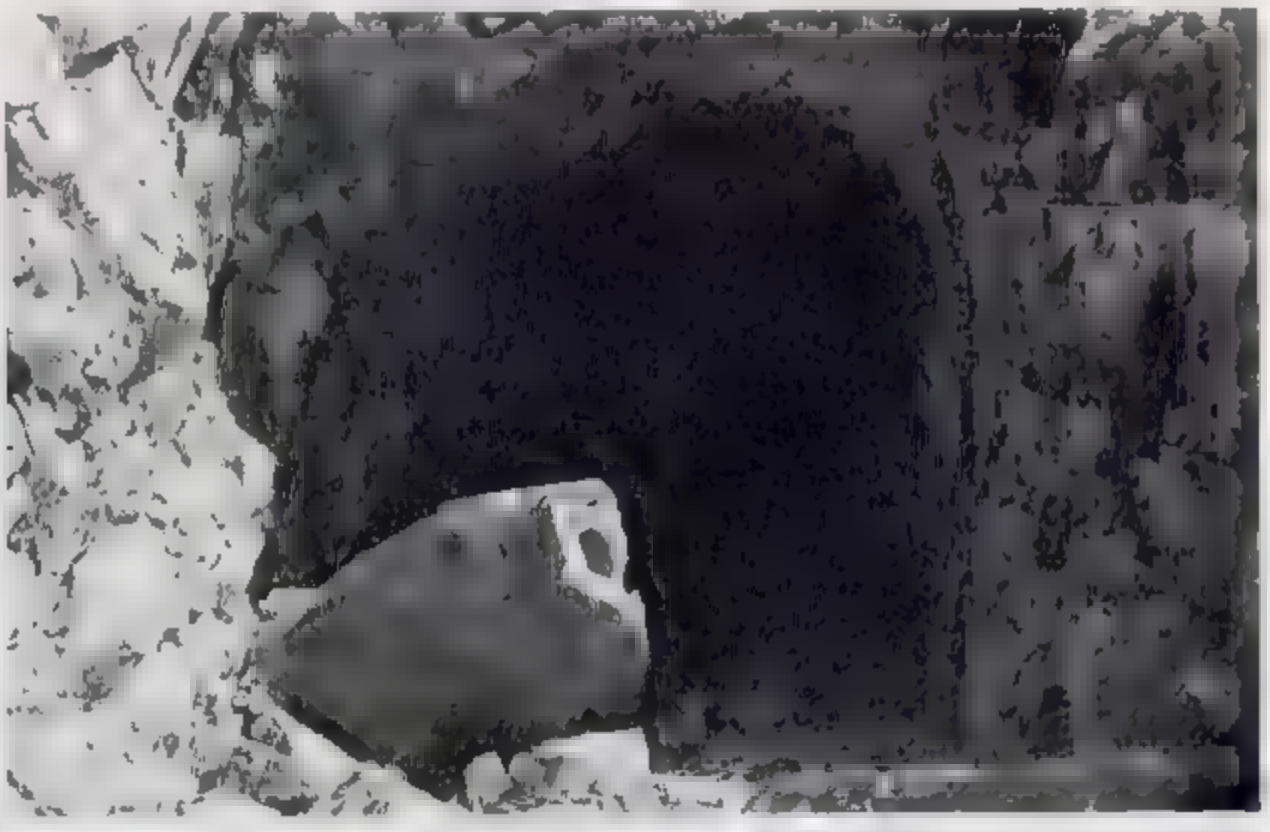
Copper Minerals of Saginaw Hill *from page 81*



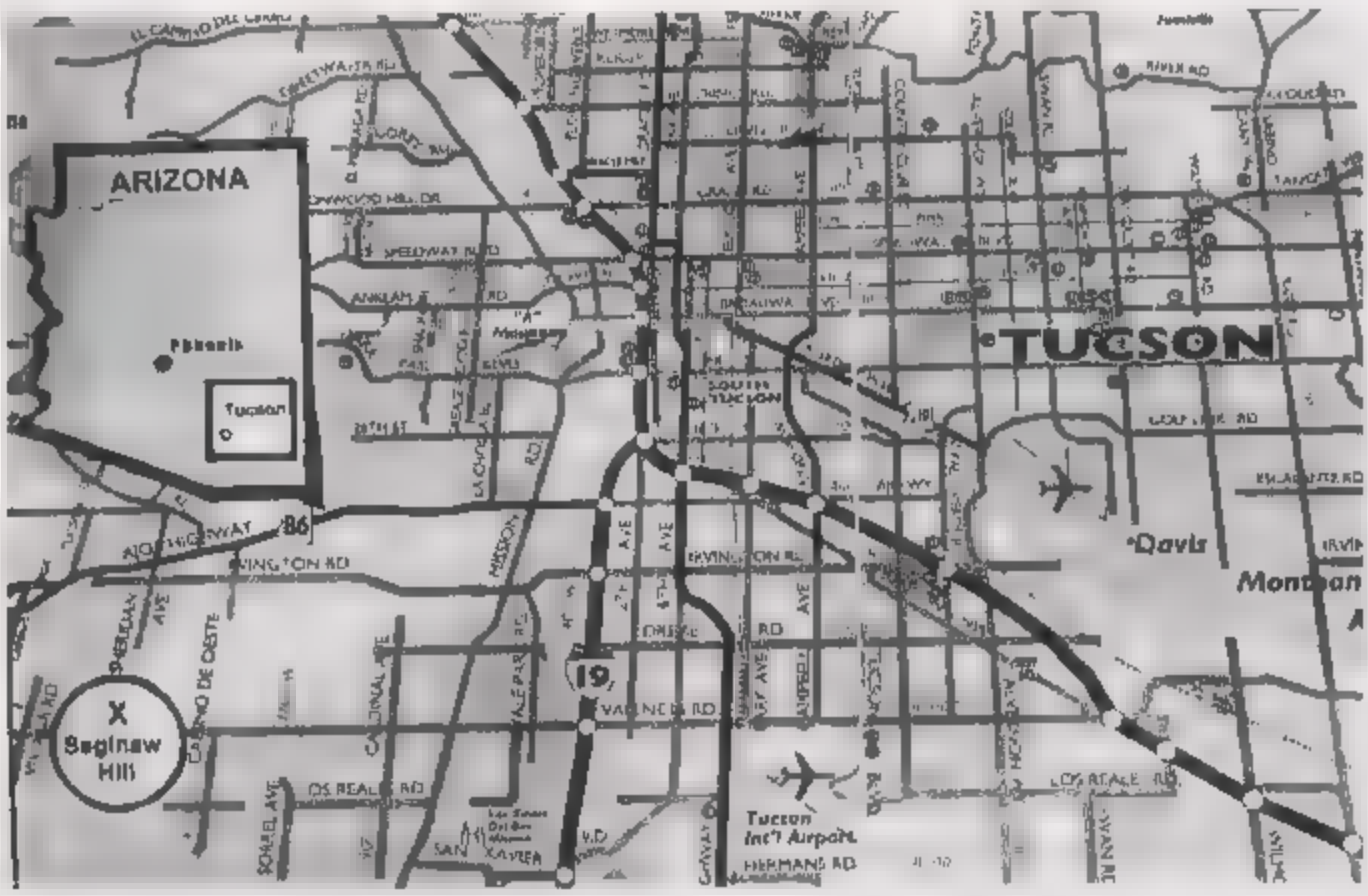
An adit was dug into the hillside to recover copper ore, but the mine has long been inactive.

I visited Saginaw Hill twice in the spring of 2004. Both trips were fun and exciting, but grueling due to all of the walking involved. Navigating the rough and rocky terrain with only a two-wheel-drive truck was no picnic. I had to eventually park and trek the rest of the way, a quarter mile, on foot. Wearing nothing more than sandals on my feet, which is not advisable, I walked the boulder-strewn mining roads criss-crossing the hill in an upward climb, taking several breaks to catch my breath and wipe my forehead. I frequently gazed outward to take in the surrounding view. I could see more than 30 miles in any direction. Just as frequently, I looked toward the rock faces of the hill for signs of color, which indicate minerals are present. The walk back down was easy. Thank goodness for gravity. The next morning, aches in my back and legs testified to the intensity of my rock-collecting venture.

Access to the Saginaw Hill Mine is off Interstate 19 and west along Valencia Road for 5.5 miles. Saginaw Hill is to the immediate north of Valencia Road and can be easily seen. The Casino Del Sol is across from Saginaw Hill on the south side of the highway. About 0.25 mile before (east of) the casino, turn off Valencia onto a dirt road heading north toward the large hill. Saginaw Hill sits about 0.5 mile off Valencia. Once off Valencia, you'll have to use your own judgment as to how to proceed, as there are many old roads from which to choose.

The old dirt roads are washboard rough. Without a high-clearance, four-wheel-drive vehicle, once off the highway,

continued on page 84



Copper Minerals *from page 82*

you may have to park and walk the rest of the way to the hill. Use care when crossing a dry wash with a long-wheel-base vehicle to avoid becoming stranded between the opposing banks. I did this twice with my two-wheel-drive pickup. Don't count on a passerby or anyone being near to help you out of a dilemma like this. It's a good idea not to go into the desert alone and to carry a cell phone in case an emergency should arise. After a day of rockhounding, stop in for a bite to eat at the casino across the street and enjoy some gaming, if you choose. The Casino Del Sol features many fine restaurants and a large gaming floor.

The Sonoran Desert is a special, but very dry and hot place, and extends from southern Arizona into Sonora, Mexico, and includes most of Baja California. It is home to the legendary saguaro cactus, which can live to be 200 years old, as well as mesquite, paloverde and Joshua trees, ocotillo, creosote and brittle bushes, and prickly pear, cholla, and barrel cactus. Most desert plants have thorns. Coyotes, javelinas, bobcats, and cougars wander the area, as do many poisonous snakes, spiders, scorpions, and lizards. Should you be a novice to the desert, watch where you walk to avoid snakes and holes and rocks that can turn an ankle. Stay clear of all cacti, especially the "teddy bear" cholla, if you brush against it, long, sharp needles will firmly imbed themselves in your skin. You may have to use a comb to remove them.

And yes, you can die in the desert due to heat and dehydration. The Southwest is very hot during the summer (June through September), temperatures can soar to 112 degrees F and higher. Hundred-degree afternoons are an everyday occurrence. The best times to visit are fall, winter or spring. Summer is off-season. Take plenty of water. The body heats up and quickly dehydrates in a hot desert.

While in Tucson, you can visit three excellent introductions to the Sonoran Desert: Sabino Canyon, located at 5900 N. Sabino Canyon Rd., the Arizona-Sonora Desert Museum, located at 2021 N. Kinney Rd., and the Red Hills Visitor Center, located at 2700 N. Kinney Rd. There is a fee for visiting the canyon and museum, but the visitor center is free. Sabino Canyon offers a fun narrated tram ride through the first few miles of the Santa Catalina Mountains. The museum and visitor center have as a backdrop the beautiful Tucson Mountains. Most of this chain is protected and sits in the Saguaro National and Tucson Mountain parks. Saginaw Hill sits just outside the park boundary.

ROCK SCIENCE

by Steve Voynick

Garnet: A Better Abrasive

Most rockhounds usually think of garnet primarily in terms of gemstones and specimens. That's because the deep-red pyrope and rich-green grossular (as in the tsavorite variety) are fine gemstones for jewelry use while garnet dodecahedrons are nice additions to mineral collections.

Less familiar, however, is garnet's growing role as an industrial abrasive. While only small amounts of garnet serve as gemstones or specimens, thousands of tons of garnet are mined each year for industrial purposes, mainly as abrasives. While sand (quartz, or silicon dioxide) remains the most widely used abrasive, garnet is now displacing sand in many applications.

Garnet is a general term for a group of complex silicate minerals with a similar crystalline structure and diverse chemical compositions. Garnet's general chemical formula is $A_3B_2(SiO_4)_3$, with "A" representing such divalent metallic ions as calcium, magnesium, ferrous iron, and manganese and "B" representing trivalent ions like aluminum, chromium, ferric iron, and manganese. In certain rare garnets, the "B" cation may also include vanadium, titanium or zirconium ions.

The garnet group includes some 15 members, many of which form solid-solution series. The most familiar and abundant garnets are almandine, pyrope, spessartine, grossular, andradite, and uvarovite. Garnet group members vary widely in color, but only slightly in hardness, density, and index of refraction.

Garnet crystalizes in the cubic system, usually as dodecahedrons. Its Mohs hardness is 7.0 to 7.5, a bit harder than quartz (Mohs 7.0). But with a specific gravity ranging from 3.56 to 4.32, garnet is considerably denser than quartz (specific gravity 2.65).

Garnet was first mined in the 1880s for use as an abrasive to polish steel. For more than a century, it served primarily in special abrasive applications, but quartz, often in the form of common sand, remained the preferred industrial abrasive because of its very low cost. But in recent decades, industrial users have taken a closer look at garnet for three reasons: it tends to break into sharp bits, it can be easily recovered by simple gravitational separation methods, and it is nontoxic.

Under the severe stresses of abrasive use, garnet and quartz behave quite differently. While both have a conchoidal fracture and no cleavage planes, quartz's tetrahedral atomic structure makes it the tougher and more durable mineral. Quartz breaks into rounded grains of the type found in the world's dune fields and beaches. But garnet grains do not become rounded; instead, they break into sharp-edged bits that retain their abrading efficiency much longer than quartz.

The petroleum industry uses huge amounts of abrasives as sandblasting agents to clean compacted, quartz-based mud and silt from drill pipes and well casings. Quartz sandblasting mediums can be used just once. But garnet mediums, with their significantly greater density, can be recovered by simple "washing" methods similar to those used in placer mining. And because these garnet bits retain their sharpness, they can be recycled many times.

Garnet also has important health-related advantages. In sandblasting use, quartz forms an airborne dust of fine silica particles which, when inhaled, form silicic acid. Over time, silicic acid can literally petrify delicate lung tissues and greatly impair pulmonary function. This debilitating industrial disease, called silicosis, can be fatal. Although garnet also forms an airborne dust, it is nontoxic, a big consideration in our age of health concerns and employer liability issues.

Thus, while quartz sand costs far less initially, garnet is cheaper in the long run in many abrasive applications. Garnet powder and grit are also used to polish optical lenses and as a medium in filtration systems for water and industrial liquids. Today, 335,000 tons of garnet, mostly almandine and pyrope, worth $50 million are mined worldwide each year. The United States, with mines in New York, Idaho, and Montana, is the world's leading garnet producer. Australia ranks second. Garnet is common worldwide, especially in metamorphic rocks. In certain gneisses and schists, garnet sometimes accounts for more than half the entire weight of the host rock.

So while garnet does have its place in gemstone and specimen use, its real claim to fame is as a better abrasive.

FIELD TRIP

Lake Valhalla Serpentine

This New Jersey Collecting Site is Often Overlooked

The serpentine at Lake Valhalla is a waxy yellow and often occurs as rounded grains in an extremely hard white to dark-gray matrix. (Photos by the author)

by Robert Beard

New Jersey is one of the most unique states for collecting minerals. The state is often the subject of jokes from outsiders and usually brought up in the context of gambling, chemical plants, and organized crime. Few people, if they hear you are going to New Jersey, will assume that it is for mineral collecting.

However, many collecting localities in New Jersey offer minerals that are available nowhere else, and virtually no other state offers such variety of collecting near so many major metropolitan areas. The fluorescent minerals of the Franklin-Sterling Hill area in northwestern New Jersey are probably the most famous of New Jersey minerals, but the state offers many other interesting collecting opportunities.

New Jersey has the double benefit of having unique geology and relative proximity to many universities. New Jersey rocks are among the most studied in the world. The southern two-thirds of the state is mainly Tertiary through Cretaceous sediments, many of which are relatively recent coastal plain sediments. The remaining third is a complex sequence of Paleozoic and Precambrian rocks, many of which have been tightly folded and intruded by huge Triassic dikes of diabase.

The southern coastal plain sediments provided raw silica for the early American glass industry, and many of the bog iron deposits in the sediments provided ore for the first iron producers in the country. The northern Precambrian rocks hosted zinc and iron ores for the paint and steel industry, and many of the diabase dikes became huge quarries for the construction aggregate industry.

Having such rich resources so close to major cities like New York and Philadelphia made it much easier to exploit and study the rocks. The interest in mining and manufacturing in New Jersey undoubtedly spurred much of the geologic research in the state. Not surprisingly, most of the early research focused on the rocks in northern New Jersey, as this is where the most complex geology and greatest ore deposits were found. Some of the best geologists and mineralogists of the late 19th and early 20th centuries, including Charles Palache, Clifford Frondel, and James Furman Kemp, studied the geology and minerals of northern New Jersey. Even John Sinkankas began by collecting minerals in northern New Jersey as a youth.

Zones of yellow serpentine on the sides of the quarry walls are difficult to break out.

So much emphasis has been placed on the fluorescent minerals of the Franklin-Sterling Hill area that it is easy to miss some of the other interesting collecting opportunities nearby. A good example of a great collecting site that is often overlooked is the deposit of yellow serpentine near Lake Valhalla, which is just west of Montville in Morris County. This locality is often referred to as the Lake Valhalla serpentine or Montville serpentine. The bedrock geology is similar in some respects to the rocks around Franklin-Sterling Hill, but there are no fluorescent minerals—at least none that I am aware of—at the Lake Valhalla locality.

The yellow serpentine at Lake Valhalla makes an excellent collecting trip for individuals or small groups. It is easily reached from Interstate 287, and reaching it only requires a short hike over forested land. A sign on the trail indicates that it is maintained by Volunteers of the New York-New Jersey Trail Conference, and the trail is for foot travel only. Horses and wheeled vehicles are prohibited. During my visits to the site, I have not come across any regulations that specifically prohibit mineral collecting. I first learned of the locality from *Gem Trails of Pennsylvania and New Jersey*, by Scott Stepanski and Karenne Snowe (Gem Guides Book Co., Baldwin Park, CA). This is a great guide for collecting in the region, and I have always found that sites in this book have not had problems with prohibitions on collecting. Many of the mineral clubs in the region also have taken field trips to the area, based on information I have seen on the Internet.

Serpentine is a relatively common mineral in many parts of the world, and is often an interesting mineral for collecting. It is found in both igneous and metamorphic rocks, and since its composition can vary, serpentine is best referred to as a mineral group rather than an individual mineral. The chemical formula is generally close to $Mg_3Si_2O_5(OH)_4$, and iron and nickel sometimes substitute to varying extents for magnesium (Mg), aluminum (Al), and sometimes silicon (Si). The most common color of serpentine, of course, is green. The yellow of the Lake Valhalla serpentine is what sets this collecting locality apart from other serpentines.

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Bands of white chrysotile in yellow, waxy serpentine are a real prize and can be found if you look hard and long enough.

The quarry walls are made of gray crystalline rock, smooth dark-green serpentine, and many veins and stringers of yellow serpentine.

The quarry floor is covered with leaves, which often hide loose pieces of nice serpentine.

Lake Valhalla Serpentine *from page 89*

Serpentine minerals have tremendous importance in geologic processes. Serpentine is especially common in metamorphosed mafic rocks, which are dark-colored rocks that are rich in iron and magnesium. Rocks with large amounts of serpentine generally weather more rapidly than other rocks, and this often leads to iron-rich soils and unstable hillsides. In many cases, the amounts of residual iron and manganese are so high that very few plants can grow in the soils, and this often leads to distinct terrains. In the mountains, such as the Sierra Nevada and Coast ranges in California, bodies of serpentine are often identified by a red appearance and relatively barren slopes. In flatter areas, such as the Piedmont of the northeastern United States, serpentine bodies are identified by a general lack of vegetation and preponderance of small pine trees. This has often earned them the well-deserved name "barrens," especially in southern Pennsylvania. On geologic maps, serpentine bodies are almost universally shown as purple, and this is a good way to spot serpentine collecting localities when checking maps in geologic reports. However, while the rocks at the Lake Valhalla locality contain serpentine, the host rocks are not considered mafic, and the geologic maps that I have seen do not show the area as a serpentine body.

Chrysotile, an important serpentine mineral, has had enormous importance to people and industry. It is best known as the main mineral of asbestos. Asbestos has been used in practically everything that needs protection from heat and flame, and was often used in roofing materials, floor tile, pipe insulation, and brake linings. Its unique properties are difficult to replicate with substitutes, and the substitutes are often more dangerous than the asbestos. Asbestos has gone from being among the most useful to among the most damaging of minerals, from both a health and liability standpoint. While asbestos has proved to be an excellent flame retardant and insulator, the fibers are dangerous to breath, and long-term exposure can result in asbestosis or mesothelioma.

While no one can dispute that breathing large amounts of asbestos is bad, no one ever seems to bring up the good that this mineral did for people. Remember when entire cities and blocks of row homes would go up in flames every few years? Asbestos roofing and building materials undoubtedly saved thousands of lives over the years. Asbestos brake linings, pipe, and gaskets also saved many lives, but how many we will never know. Nowadays, more people are killed by asbestos substitutes that result in exploding brake drums and blasts from failing steam valves than would have died if asbestos was still used in these products. Although modern technology could be combined with asbestos to make manufacturing and use virtually 100 percent safe, the fear of litigation and damage awards has all but wiped out the asbestos industry.

Bands of white chrysotile are found within the rocks and are exposed by breaking apart larger pieces.

The Lake Valhalla site was also described in "The Serpentine Locality at Montville, New Jersey," by Earl V. Shannon, in *American Mineralogist* (Volume 12, No. 2, March 1927). At the time of the article, Shannon indicated that he believed the quarry had not been operated for 35 years, which would mean that as of 2004, the quarry has been inactive for over 100 years. The bedrock geology is described as Franklin Limestone. Shannon indicated that he had some difficulty finding the quarry, but once he found it, he found serpentine specimens in abundance. He interpreted the origin of the serpentine as due to an alteration of diopside, which may have resulted from fluids from a pegmatite exposed in the quarry. He also noted that the serpentine had been determined to have 2 percent more water than ordinary serpentines, so it was comparable to retinalite, which is a mixture of serpentine and deweylite. Retinalite and deweylite are serpentine minerals that have more water and often have a waxy appearance. Shannon indicated that he had found specimens ranging from translucent light yellow-green to dark black-green. Other minerals that he found in the quarry included granular dolomite, chrysotile, picrolite, and phlogopite. Unfortunately, like many of the articles in the *American Mineralogist* of that period, there are no pictures and no maps.

I first went to the serpentine locality in April 2002. The locality is right on the boundary of the Boonton and Pompton Plains quadrangles, and there is no indication of the site on these maps. It was tricky to find the trail, as you have to park near someone's house and cross along the side of their yard to get to it. Fortunately, I did not experience any accusations of trespassing, and was on the trail quickly. The hike is an easy climb over relatively level ground, but it climbs steadily higher.

Since it was April, much of the vegetation had not grown in, and I was able to see the ground fairly well. I kept my eyes open for signs of yellow rocks on the trail. As I was becoming concerned that I would not find the place, I found some yellow fragments. I soon found many more pieces, and knew I was in the right area. I came up to a rounded ridgeline, and saw what looked like a large man-made cut in the hill. It was obviously quite old, as there were large trees growing in the cut. The rocks were well-exposed in this area, and it was undoubtedly a former quarry.

The quarry walls were of extremely hard gray crystalline rock, smooth dark-green serpentine, and many veins and stringers of yellow serpentine. This was the site. I was able to find many nice pieces of yellow serpentine, as well as some good pieces of green serpentine. I was very impressed with the area as a collecting spot.

I thought I had collected more than enough good pieces, but I wound up giving away and selling some of my best specimens. I sold some of the yellow serpentine in Socorro, New Mexico, at the New Mexico Mineral Symposium Silent Auction in November 2002, and when I told people it was from northern New Jersey, many people asked if it was fluorescent. Unfortunately, even though it is in the same region as the rocks from Franklin and Sterling Hill, I have not found any indications of fluorescence. However, the appearance of the yellow serpentine by itself made it attractive to buyers, and I soon found I had hardly any pieces left. I returned to the site in July 2003 to see if I could get some more good pieces.

Collecting in the Northeast in July is always vastly different than collecting in spring or fall. Vegetation becomes much thicker in summer, and this often obscures collecting sites. Fortunately, I was still able to find the trail easily, and since I had been to the quarry area before, I easily found the site.

The quarry is slightly obscured by trees, and while there are some briars, poison ivy, and other plants, they were generally avoidable. I arrived late in the afternoon, and found the biggest prob-

continued on page 98

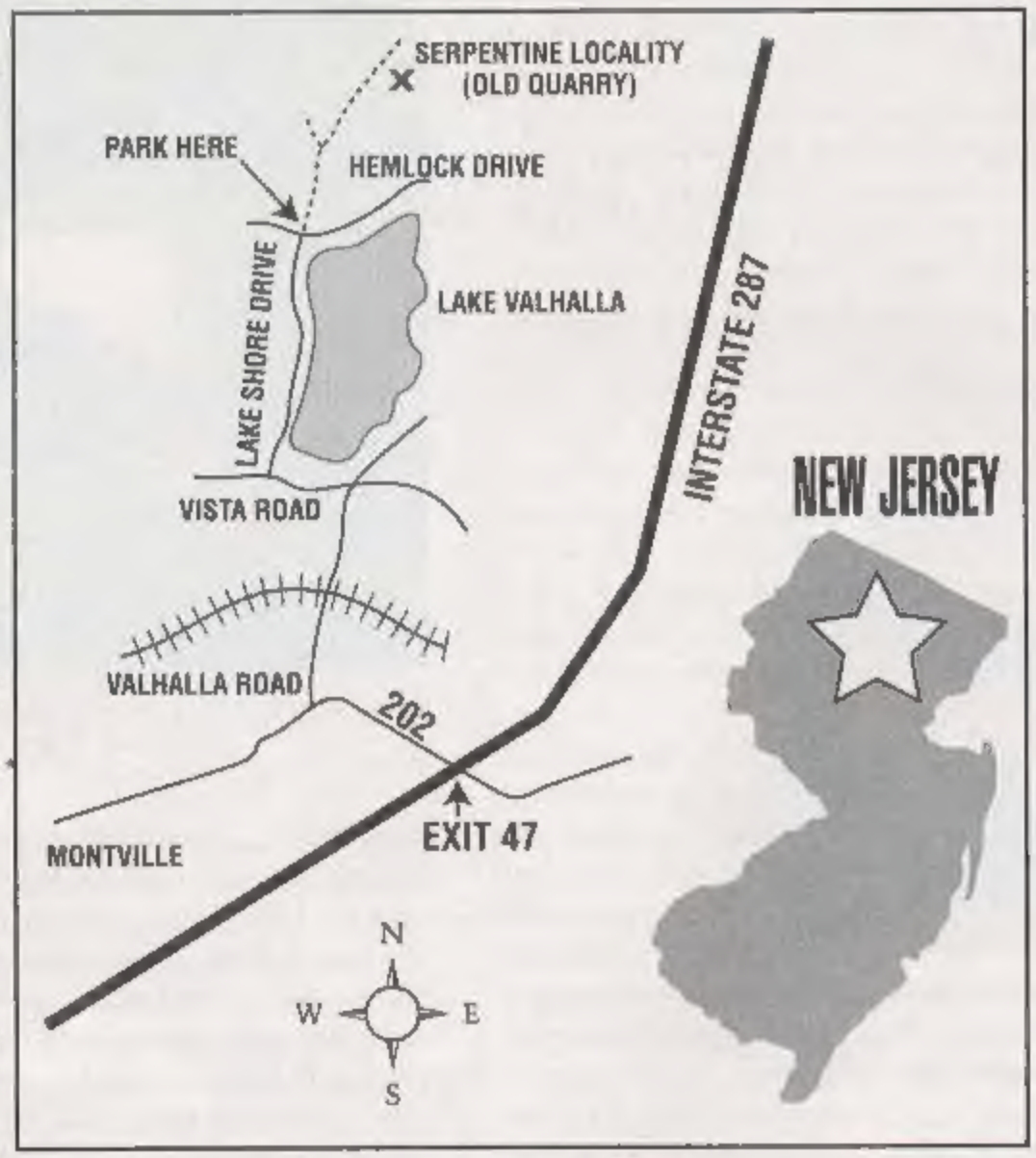
lem was trying to get good photographs for documenting the conditions at the site. The light was poor, and got even worse once the sun went below the tree line. However, it was more than adequate for collecting rocks.

This time, I saw that other collectors had recently been to the site. They had left some of their collecting scraps behind. I often find that the bits and pieces of rocks left behind by previous collectors are sometimes much better than what I can find. They had encountered an area of yellow serpentine with white fibrous bands of chrysotile, and some of the pieces were striking. They were yellow and waxy, and the white, fibrous banding was prominent.

I spent the next hour or so investigating the pit. I had my hammer and chisel, and was able to break apart some nice pieces with gemmy yellow serpentine in a matrix of white crystalline rock. It soon was apparent that the easy-to-get material had been removed long ago. The quarry walls had some beautiful sections of smooth green serpentine and waxy yellow serpentine, but try as I might, I could not break out many good pieces. The rocks at the site are extremely hard, and this is definitely not a place to come without a good hammer and chisel and eye protection.

I learned another interesting technique at this site, one which I normally cannot use at my desert collecting sites. Although it was July, the leaf cover in the quarry is extremely thick. I found that I could dig through the leaves and find large rocks that had not been evaluated as much as the pieces on the quarry walls. I was able to use my hammer to break them up, and many of them had excellent interiors of white rock with yellow crystals of serpentine.

If I had brought a rake, I probably could have uncovered many more rocks on the floor, but I normally never take a rake with me. This could be a useful tool at this site. Since the rocks are so hard, a sledgehammer would be a good tool for breaking apart the rocks on the quarry floor. I would be extremely careful with using a sledge on the quarry walls, however, as the walls are often wet and slick, and you do not want a sledge bouncing back at you. I am always leery of swinging a sledge, hitting an uneven surface, and twisting my wrists to the point where I can no longer even swing my hammer.



Good work gloves and safety glasses are also important at this site. While the serpentine is often smooth and waxy, the white crystalline rocks are rough and jagged, and will slice your hands to ribbons quickly. The gloves are also important when rooting through the leaves and turning over the rocks on the quarry floor. The leaves are wet and full of organic matter, as well as ants, spiders and centipedes. With good gloves, you will not have to worry about cutting the trip short because of a bug bite.

I was able to find many nice pieces with yellow serpentine, and some beautiful pieces with green-and-white banding. The yellow serpentine often appears in distinct grains, which suggests that it may be an alteration product of the diopside. I was a little disappointed that I could not find any additional large banded pieces with the yellow serpentine and the white fibers, like I had found on the scrap pile, but I am sure there are still some areas with these pieces. I also found later that the rocks take on an especially beautiful appearance when wet. I left some of my broken pieces on my front porch, and after it rained, the yellow serpentine was extremely bright against the dark-gray matrix of the host rock. This suggests that the rocks will be especially nice if cut and polished properly.

To get to the Lake Valhalla yellow serpentine locality, take I-287 to Montville (Exit 47), and head west for approximately 0.2 mile on U.S. Highway 202. Turn right (north) onto Valhalla Road and go under a railroad, which is approximately 0.2 mile up the road. Continue another 0.4 mile, and you will pass between two pillars for a housing development. The road is now called Vista Road. Turn right onto Lake Shore Drive, and drive approximately 0.8 mile along the west side of Lake Valhalla. Lake Shore Drive ends at Hemlock Road. Bear right, and then turn left onto a small road. Turn your car around, and park on the west side of this road. Parking is very limited here; as I recall, there was only space for one or two cars. Unlike most places I know in New Jersey, the street signs are generally well marked in this area.

From the parking area, walk into the woods and look for a trail. Walk up the trail, and in approximately 10 minutes you will come to an intersection with a trail that goes off to the left. Stay on the trail to the right. Continue for another 10 to 15 minutes, and as the trail climbs up to the top of a low ridge, look for the quarry on the right. It is very indistinct, and it may take you a couple passes to find. Keep your eyes peeled for pieces of yellow serpentine on the ground as a further guide to when you are getting close to the quarry.

The Booton and Pompton Plains quadrangles are useful, but not really necessary to find this site. The only real drawback to the site is the lack of parking near the trailhead. If you come with more than one car, you may have to park farther down the road and walk in. As always, you must respect the neighbors whose houses are near the trailhead, and make certain that you do not disturb them when accessing the trail.

The Lake Valhalla yellow serpentine locality is a must visit if you ever have the opportunity to visit this part of New Jersey. It offers relatively easy access and excellent collecting, and you will not find rocks like this anywhere else. While you can access the site year round, the best time for a visit is spring or fall. Regardless of when you go, make sure you bring a good hammer, chisel and gloves, and be ready for some hard hammering.